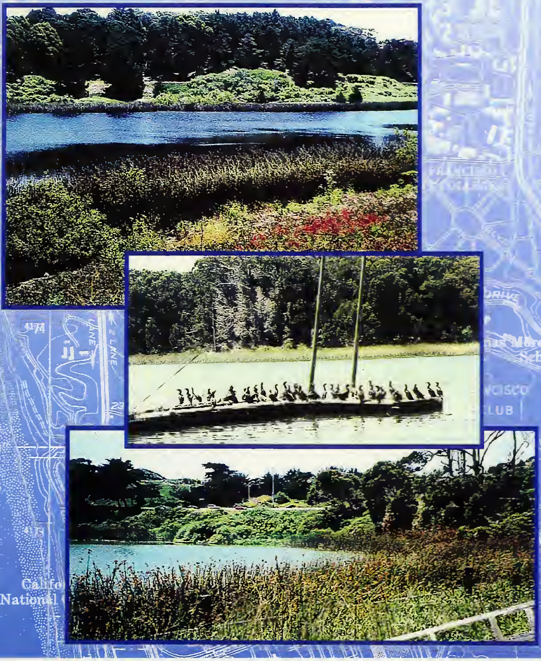
Report

San Francisco
Public Utilities
Commission

Lake Merced 1998 Baseline Natural Resources Inventory

Camp Dresser & McKee Inc.
Trihey & Associates, Inc



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LAKE MERCED
1998 BASELINE NATURAL RESOURCES INVENTORY

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LAKE MERCED

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Chapter .... Page

1 Introduction 1-1

1.1 Purpose and Objectives 1-1

1.2 Background 1-1

1.3 Mapping Procedures 1-4

2 Soil Types of Lake Merced 2-1

2.1 Soil Types and Characteristics 2-1

2.2 Soil Erosion and Slope Stability 2-3

3 Vegetation 3-1

3.1 Vegetation Types 3-1

3.2 Sensitive Plant Species 3-6

3.3 Invasive Plants 3-6

3.4 Wetland Vegetation 3-7

4 Wildlife 4-1

4.1 Wildlife Habitats 4-1

4.2 Special Status Animal Species 4-5

5 Fisheries 5-1

5.1 Fish Species Inventory 5-1

5.2 Cool Water Fisheries 5-3

5.3 Warm Water Fisheries 5-4

5.4 Special Status Species 5-9

5.5 Fisheries Summary 5-9

6 Recommendations 6-1

6.1 Introduction 6-1

6.2 Vegetation Monitoring Recommendations 6-1

6.3 Wildlife Monitoring Recommendations 6-2

6.4 Fisheries Monitoring Recommendations 6-2

3 1223 05765 1284

7 Photographs _______________ *7-1*
8 Literature Cited _______________ *8-1*

Appendices

Appendix A. _______________ ***Vegetation***
Appendix B. _______________ ***Wildlife***

List of Figures

1 Vegetation Types of Lake Merced.. 1-2

List of Tables

1 Special Status Plant Species Potentially Present At Lake Merced 3-6
2 Lake Merced Plant Communities, Habitat Types, and Associated Special Status Animal Species.. 4-7
3 CDFG Fish Species Observations for Lake Merced (1949-1989).................. 5-2

List of Photographs

1 Top of soil fall on the north shore of East Lake... 7-2
2 Heavy foot traffic area by Impound Lake.. 7-2
3 Example of gully. 7-3
4 Steeply sloped shorelines of East. 7-3
5 Arroyo willow series on northeast shore of East Lake 7-4
6 Young pine trees in standing water along east side of Impound Lake 7-4
7 Coyote brush series... 7-5
8 Wallflower within coyote brush series. 7-5
9 Coyote brush/blackberry scrub.. 7-6
10. Bulrush series.. 7-6
11. Water smartweed 7-7
12. Tamarisk 7-7
13. Forest habitat 7-8
14. Marsh habitat. 7-8
15. Interface of marsh, open water and upland habitat. 7-9

List of Plates

1 Soil Types of Lake Merced

2 Plant Communities of Lake Merced

3 Special Status Species Habitat

CHAPTER 1 INTRODUCTION

The City and County of San Francisco Public Utilities Commission (SFPUC) in concert with the Recreation and Park Department (SFRPD) is developing a comprehensive management program which addresses water supply, urban recreation, and natural resources at Lake Merced. As part of the management program (Lake Merced Comprehensive Management Plan, Draft, April 1998, Action WRS-13), SFPUC conducted a baseline assessment of natural resources in and around Lake Merced. This document reports the findings of the baseline natural resource assessment performed by Trihey and Associates, Inc. (Trihey) during late spring of 1998.

1.1 PURPOSE AND OBJECTIVES

This baseline natural resource inventory documents existing 1998 spring/summer plant and wildlife resources on City and County of San Francisco property around Lake Merced (the Lake). These data provide baseline information ultimately needed to understand and enhance the designated beneficial uses of the Lake. The study area encompassed by the inventory is delineated in Figure 1.

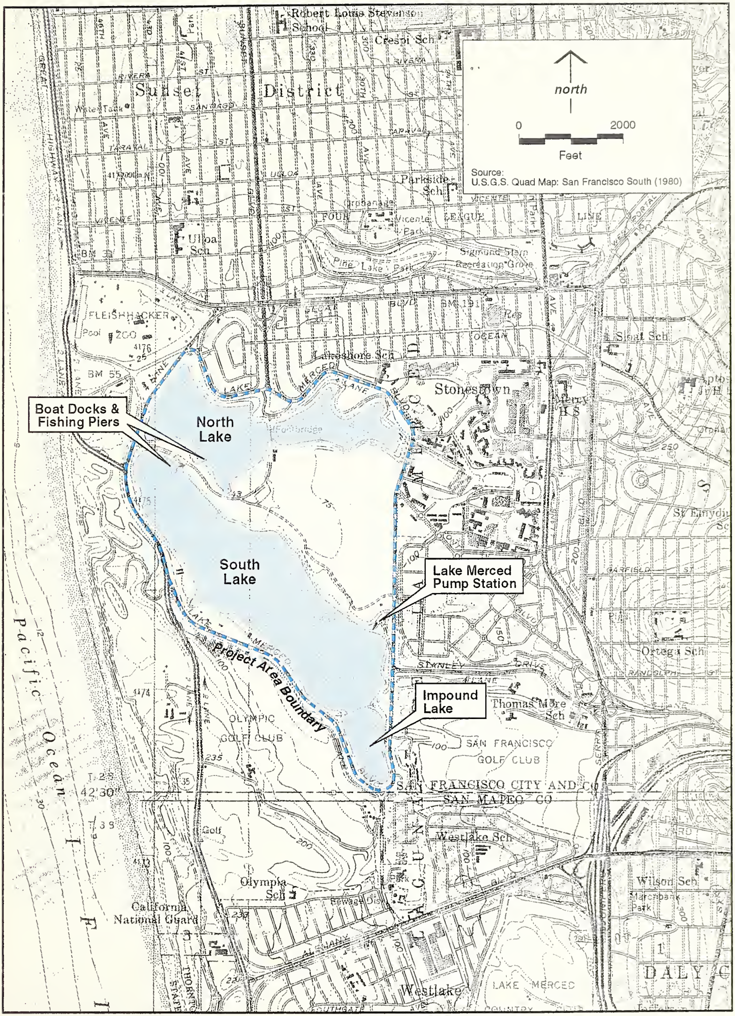
Objectives of the baseline natural resource inventory include:

- identify and describe plant communities and dominant species;
- qualitatively assess existing aquatic habitat conditions;
- assess potential habitat conditions for amphibians, aquatic reptiles, and other upland species;
- assess habitat availability and conditions for sensitive species, including the federally threatened California red-legged frog;
- describe soil conditions and assess erosion potential; and
- map plant communities, wildlife habitat areas, and soil conditions.

This inventory forms an initial, compiled version of a range of natural resources data for Lake Merced, in a computer-based format that allows for its continued use and development. SFPUC & SFRPD envision modification of the inventory over time as restoration planning/implementation proceed. SFRPD will integrate these data, including the database digitial map information, into their ongoing natural Areas Management Program.

1.2 BACKGROUND

Lake Merced was a natural water body with a periodic connection to the Pacific Ocean. The connection to the ocean was typically closed by a sand bar during



Source:
U.S.G.S. Quad Map: San Francisco South (1980)

CDM Camp Dresser & McKee Inc.
Trihey & Associates, Inc.

Figure 1
Project Area

most of the last two centuries until the effects of an 1852 earthquake breached the sand barrier (GeoResource Consultants, 1993). By the late 1880's, the Lake was completely separated from the ocean. About the same time, berms were constructed to divide the Lake into separate lakes: North Lake and South Lake. North Lake is nearly separated into two lakes, northeast and northwest lakes, by a strip of land with only a narrow channel between the two parts of North Lake. Impound Lake was separated from South Lake by a berm and a causeway built in the 1950s, although flow can occur between the two lakes when water levels rise high enough for them to cross the viaduct causeway. These lakes are collectively referred to as Lake Merced.

Beginning in the 1870s Lake Merced was used as a municipal water supply for the City of San Francisco (City). After 1910, use as a primary domestic water was curtailed due to poor water quality caused by increasing urban development in the watershed, and the availability of other, better quality water. However, irrigation use of lake water for the adjacent Harding Park Golf Course which began in the early 1900s, continued until the early 1990s.

The San Francisco PUC manages the Lake as an emergency water supply; in 1950 the surface of the Lake and surrounding lands were ceded to SFRPD for beneficial recreation uses, while SFPUC maintained its responsibility of the Lake as an emergency water supply. Lake Merced has been considered an important source of emergency water for firefighting and domestic use since the early 1900s and remains so today. Lake water can be pumped into the City supply system through the Lake Merced pump station.

If Lake Merced water is pumped into the distribution system, the minimum health requirements would be issuance of a boil water order (BWO) and an unsafe water alert (UWA). No permanent disinfection process exists at the Lake Merced Pump Station. A portable chlorination system exists at the Water Quality Bureau's Millbrae yard and can be made available for Lake Merced if necessary. Water used for firefighting would require screening, but not disinfection.

The Lake Merced Pump Station receives SFPUC imported potable surface water for distribution to the Sunset and Sutro Reservoirs. The pump station can also draft water from the Lake for distribution into the reservoirs for emergency use using two pumps designated for emergency use. Direct pumping can be achieved by using SFFD fire trucks. Lake Merced water can be transported through the western half of the City for firefighting, or to the SFFD's Auxiliary Water Supply System.

1.3 MAPPING PROCEDURES

Included with this report are three maps, referenced as plates, portraying soils, plant communities and special species habitat. The maps were developed as overlays on high resolution 1993 orthorectified aerial photographs produced by HJW and Associates Inc., an aerial photography company. Field mapping of plant communities was conducted on maps at a scale of one inch to 200 feet. Habitat boundaries from field maps were transferred by digitizing the hand-drawn boundaries into the digital photograph file. Soils maps were produced by transferring 1991 USDA soil survey mapping units to the aerial photograph. The aerial photograph plate represents a composite of fifteen 90 megabyte files merged into a single file. The final maps present the findings described in this report from field surveys conducted in late spring 1998.

The plates were created as AutoCAD Release 14 files in a format compatible with a Geographic Information System (GIS) to assist in their future periodic updating to reflect the dynamic natural environment at Lake Merced.

CHAPTER 2 SOIL TYPES OF LAKE MERCED

The soils surrounding Lake Merced are compressed of material derived from soft marine sandstones, that were redistributed through alluvial and coastal geomorphic processes (USDA, 1991).

Preliminary soil surveys from the early 1900s mapped the north and east margins of Lake Merced as Antioch sand and loamy sands, and the southwest side as Altamont sands and sandy loams (USDA, 1917). The Antioch sand and loamy sands were noted as being on sloping, slightly rolling or modified (cut and fill) coastal terraces in unconsolidated sedimentary deposits. The Altamont sands and sandy loams were mapped on rolling, hilly or steep areas with relatively thin soils over sandstone and shale bedrock. Recent soil surveys (USDA, 1991) reflect the change in the landscape due to urban development on the terraces and dunes and terminology changes as part of the modern USDA soils classification system. Surface soils have been altered, removed or covered over in the urban areas surrounding Lake Merced, primarily on the upland terrace surfaces. On the relatively steep side slopes along the Lake shores, relatively little direct modification of the soils has occurred, except for foot trails.

Trihey has provided soil unit map boundaries for Lake Merced using the recent soil survey (USDA, 1991) in the “soil” GIS layer (See Plate 1,”Soil Types of Lake Meced”). The following description of the major soil types in the project area is based on both prior published surveys (1917 and 1991) and the 1998 field observations by Trihey.

2.1 SOIL TYPES AND CHARACTERISTICS

Generally, soils vary in chemical and physical properties according to differences in parent material, slope angle and aspect, water, temperature, drainage, vegetation and age. These properties affect their suitability for various watershed, habitat, agricultural and urban uses and their sensitivity to disturbance as a result of inappropriate use. All of the local soils at Lake Merced have similar sand-textured geologic parent materials, although the terrace soils (on the north, east, and south) are underlain by slightly more resistant, but still poorly consolidated bedrock compared to the dune areas (to the west). The underlying Colma Formation is comprised of fine to medium grained sand with minor sandy silt, clay and gravel interbeds. (USGS 1974). However, the Colma formation is a weak bedrock unit compared to the more competent bedrock of the Franciscan complex, found at depth. Due to their similarities in mineral content, texture (sand, loamy sand, sandy loam) young relative age, all of the local soils are susceptible to water and wind erosion when unvegetated.

Orthents, Cut And Fill, 0 To 15 Percent Slopes (Map Symbol 121)

Orthents are well drained soils on alluvial fans, coastal terraces, and hills between portions of Lake Merced (i.e., Harding Golf Course). Orthents only exhibit limited soil development features relative to their geologic parent material (e.g., dune sands). For example, they have slight organic matter accumulation near the surface, but lack distinct horizonations (layers) or clay accumulation from long-term soil development processes. These soils have been graded for recreational development and are nearly level to sloping. They vary in thickness and in the texture of the surface material, and in some areas topsoil has been amended or supplemented[1]. Because of the differences in grading and the addition/removal of soil material, properties of this soil mapping unit are not easily generalized. However, regardless of these differences, the hazard of water erosion is generally moderate and increases in areas of disturbed vegetation.

Orthents, Cut And Fill-Urban Land Complex, 5 To 75 Percent Slopes (Map Symbol 124)

This soils complex occurs on uplands along coastal terraces, with about 50 percent urban land. The Orthents, cut and fill Urban Land complex areas are gently rolling to very steep, but vary in soil thickness and surface texture. Extensive cut and fill terraces have been constructed on side slopes for urban land uses in some locations with these soils. In the vicinity of Lake Merced, only the upper part of the natural soil profile has typically been graded and moved (i.e., Marina area). The areas mapped as Urban Land are covered with asphalt, concrete, buildings or other artificial surfaces, but have underlying materials similar to the Orthents.

Urban Land-Orthents, Smoothed Complex (Map Symbol 135)

These soils are on coastal terraces, hills, and ridgetops, with about 65 percent urban land, such as surrounds the north, east and south ends of Lake Merced, including Impound lake. The Urban Land Orthents Smoothed Complex are well drained, gently rolling to steep soils that have been altered by grading and re-contouring for urban development. The imported fill materials are typically from soft sandstone, and generally have fine sandy loam or loam feature. Many areas that were once rolling hills have been smoothed for roadways, homesites or other similar uses. Runoff is medium to rapid in the Smoothed Complex, and the hazard of water erosion is moderate to high.

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[1] Amendments or supplements such as mulch, compost, fertilizers or stabilizers have been used for landscaping purposes.

Sirdrak Sand, 5 To 50 Percent Slopes (Map Symbol 129)

Sirdrak sand occurs along the west shore of South and North Lakes. The Sirdrak sands are very deep (over 40 to 60 inches thick), somewhat excessively drained soil on coastal dune formations. Typically, the surface layer is dark brown and dark yellowish brown sand about 17 inches thick overlying yellowish brown sand. In landscaped areas, the soils may have a loamy surface texture. Water can infiltrate rapidly and runoff is very slow. The hazard of water erosion is moderate or high and the hazard of wind erosion is high. Erosion can be extensive unless runoff is diverted, and foot traffic can disturb vegetation and create runoff concentration. Sirdrak sand poses severe limitations (due to steep slope angles and blowing soils) for building and recreational development. If used for trails, they should be built to extend across slope, and adequate plant cover must be encouraged to protect soils.

Urban Land-Sirdrak, 2 To 50 Percent Slopes (Map Symbol 136)

These soils are on stabilized coastal dunes, with about 45 percent urban land, occurring along the northeast corner of Lake Merced. Erosion is a hazard in all unvegetated and steep areas.

Urban Land (Map Symbol 131)

Urban Lands are areas that have more than 85 percent of the soil surfaces covered with asphalt, concrete, buildings and other structures. The underlying soils typically have characteristics similar to the native soils and may be susceptible to erosion when exposed.

2.2 SOIL EROSION AND SLOPE STABILITY

Trihey staff performed a field reconnaissance of the Lake Merced study area (in early summer 1998) to observe the existing slope stability and soil erosion status. The heavy and long-duration precipitation of winter 1997/98 had contributed to recent activation of slope failures along some of the steeper banks of East and North Lakes (Photograph 1). Locations with active slope failures are highlighted on Plate 1, along with areas of existing surface (soil) erosion.

Due to the soil conditions, surface erosion has, and will, occur in all areas around Lake Merced that are not stabilized by vegetation. Therefore, all areas exposed to heavy pedestrian traffic, such as informal parking areas, edges of streets or sidewalks, trails, and footpaths along fishing banks will be vulnerable to erosion (Photograph 2).

On the relatively level uplands, dislodged soil would be primarily mobilized by wind, but may contribute sediment to the Lake during major storm runoff events

(when rainfall intensity and duration exceed the relatively high permeability of the surface soils). Along steep slopes and shoreline banks, any denuded soils can easily be degraded into rills and small gullies by runoff and directly contribute sediment to the Lake (Photograph 3).

Increased slope angle, distinct differences in surface soil versus subsurface geologic material, shallow-rooted vegetation, and high water content of soils contribute to slope failures (along with seismic stress). Lower slope angles and gentler topography create relatively high stability along the southern and western margins of Lake Merced. However, there are steep, high cliffs of active and potentially active slope failures along most of East Lake, portions of North Lake, and the northeast side of South Lake (Photograph 4).

Visual inspection suggests that the existing active mass wasting features are soil-falls or soil slides along shallow failure planes of the subsurface terrace deposits or the weakly consolidated bedrock. Slides were noted in areas of both native and non-native vegetation, but rooting depth and soil moisture differences may contribute to instability. The relationship of slide locations on the cliff faces to runoff patterns and subsurface drainage off of the uplands has not been specifically investigated. However, it is possible that compacted soils along portions of the upland terraces (e.g., along trails or roads) may alter infiltration and surface runoff patterns adversely.

CHAPTER 3 VEGETATION

Vegetation series and types and their distribution at Lake Merced as of 1998 are described in the following sections. Trihey has provided vegetation data to develop GIS layers (See Plate 2: Plant Communities of Lake Merced) that indicate the location of vegetation types and certain invasive species described below. A discussion of the vegetation classification systems procedures and methods is provided in Appendix A, along with a working species list.

Lake Merced is surrounded by vegetation that grades from wetland types at the margins of the Lake to upland scrub, grassland, and forest types on the upper banks and terraces. The wetland types are dominated by native species. The upland types range from types dominated by native species, to types with a mixture of native and non-native species, to types dominated by non-native species.

3.1 VEGETATION TYPES

Various vegetation classifications have been developed historically to meet different descriptive needs (Holland 1986; Barbour & Major 1995, Sawyer & Keeler-Wolf 1995). Vegetation types in this report follow the California Native Plant Society (CNPS) series designations (Sawyer & Keeler-Wolf 1995) where possible. Areas of mixed annual grassland series and coyote brush series species into map units in which the scrub species were divided predominate versus other map units in which the grassland species predominate. Appendix A relates the vegetation types used in this report to other classifications, used previously at Lake Merced.

Tree-Dominated

Tree-dominated vegetation at Lake Merced in 1998 has been mapped in four series, one stand, and one type[2]. The willow and oak series are native to the area, one series is dominated by exotic eucalyptus trees, and the acacia type is dominated by exotic small trees (primarily acacias). While Monterey pine and Monterey cypress are not native to the Lake Merced area, they provide habitat at Lake Merced for wildlife species present in their natural range. As is the case in the native range of these species (Barbour & Major 1995), the understory of these forests at Lake Merced often consists of species present in adjacent scrub vegetation. Many of these understory species are also present in the native

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[2] As used herein, vegetation series are described based on existing plant community structure, the species present in various structural layers of the community and their relative dominance, importance, or rarity; vegetation stands are plant communities that feature structurally or floristically unique conditions, or have concentrated occurrences of single species in a uniform stand; and vegetation types are specific plant assemblages that may be subdivisions of a series or may present unique habitat conditions.

range of the trees. Therefore, the CNPS series and stand types for these forests are used in this report.

Monterey Pine Series And Monterey Cypress Stands

Monterey pine (*Pinus radiata*) and Monterey cypress (*Cupressus macrocarpa*) have been planted along the mesas around Lake Merced, especially along the margins of Harding Park Golf Course. These two species are present both in mono-specific stands and in mixed stands. Most of these forests consist of large trees. The understory is usually open, as much of it is maintained as rough along the golf course. Understory cover in the rough is mostly supplied by annual grassland species and iceplant. However, in May and June of 1998, a non-native herb, small-flowered fumitory (*Fumaria parviflora*), covered extensive areas under the pines and cypresses along the golf course. This species extended down-slope both where the conifers were present on the slope and into scrub vegetation on the south shore of East Lake. Where maintenance workers do not clear the undergrowth, the pine forest may have a denser understory of acacia trees or of bracken (*Pteridium aquilinum*), and other native shrubs such as poison oak (*Toxicodendron diversilobum*), California blackberry (*Rubus ursinus*), bush monkeyflower (*Mimulus aurantiacus*), toyon (*Heteromeles arbutifolia*), red elderberry (*Sambucus racemosa*).

Eucalyptus Series

The most common species of eucalyptus at Lake Merced is blue gum (*Eucalyptus globulus*). These tall trees are found at scattered locations around the Lake. The most extensive stands are along the west shore of South Lake and along the west and north shores of North Lake. The understory of this forest is often bare or composed of annual grassland species. However, at Lake Merced, several of the eucalyptus groves have an extensive understory of the invasive cape ivy (*Senecio mikanioides*). In places, this non-native weed is encroaching on adjacent areas vegetated with native scrub or wetland species.

Coast Live Oak Series

Coast live oak is infrequent at Lake Merced. A cluster of small coast live oak trees is present on the north slope of East Lake, northeast of the footbridge. This stand is surrounded by acacias and annual grassland.

Arroyo Willow Series

Willows provide dense cover between the bulrush series and upland series at several locations around Lake Merced. The largest stands occur where slopes of intermediate gradient are present, especially along the east shore of South Lake and the north shore of East Lake (Photograph 5). This series is dominated

primarily by arroyo willow (*Salix lasiolepis*), but includes other species of willow. Wax myrtle (*Myrica californica*) is found with this series, as well as with the coyote brush series.

Impound Lake has a narrow willow strip most of the way across its southeast end, visually dividing it into a small pond and larger pond. Young pines, now in standing water, are present at the southeast end of Impound Lake and indicate that the water level was lower for several years (Photograph 6). The presence and condition of young pines is consistent with the earlier planning study (Geo/Resource 1993) statement that Impound Lake was almost dry in 1992.

Acacia Type

Various non-native small trees or large shrubs provide the dominant vegetative cover for this vegetation type. Blackwood acacia (*Acacia melanoxylon*), star acacia (*Acacia verticillata*), and plume acacia (*Albizia lophantha*) dominate, although myoporum (*Myoporum laetum*) is occasionally found with or adjacent to the acacia species. On the west shore of South Lake, the native madrone (*Arbutus menziesii*) and red elderberry occur sporadically with acacia. These trees generally provide a dense canopy and are thick and have little or no understory.

Shrub-Dominated

At Lake Merced, coyote brush is the most widely distributed and abundant of the shrub species. There are also patches of mixed scrub with little or no coyote brush and varying dominance of other shrub species that do not fall readily into any CNPS vegetation class. The areas previously mapped by ENTRIX (1987) as yellow bush lupine (*Lupinus arboreus*) now support a mixture of shrub species or are dominated by annual grassland species. These patches of mixed shrub species are considered to be localized variants of the coyote brush series.There are some extensive areas that are nearly monotypic stands of California blackberry, which are called out as a district vegetation type.

Coyote Brush Series

Native coyote bush scrub vegetation occurs primarily on steep slopes along the north and south shores of East Lake, the northeast shore of North Lake, and the east shore of South Lake (Photograph 7). It is also present in a depauperate form on the mesa at the north side of East Lake.

The coyote brush series vegetation in the center of the mesa consists primarily of coyote brush, with a few toyon shrubs, and occasional patches of California figwort (*Scrophularia californica*). The coyote brush is intermingled with iceplant and exotic grasses and forbs.

Elsewhere, the scrub may include seaside woolly sunflower (*Eriophyllum staechadifolium*), California sagebrush (*Artemisia californica*), mock heather (*Ericameria ericoides*), yellow monkey flower, poison oak, bracken, yellow bush lupine, California blackberry, wax myrtle, powdery dudleya (*Dudleya farinosa*), and wallflower (*Erysimum franciscanum* cf) (Photograph 8). Annual grassland species are also present in these areas.

Blackberry Type

On certain slopes of Lake Merced, California blackberry forms nearly monotypic stands. Areas that were identifiably vegetated with district blackberry stands were noted on the west shore of South Lake, the southwest shore of North Lake, and the south shore of East Lake.

Much of the area previously mapped by ENTRIX (1987) as blackberry is on steep slopes that are overgrown with wild cucumber (*Marah fabaceus*) as of this survey by Trihey, (1998, Photograph 9). The slopes were wet in spring 1998 and included areas with recent slippage. Therefore, no attempt was made to descend these slopes to more closely identify the vegetation. While some areas on these inaccessible slopes were visibly vegetated with blackberry, other areas featured a mixture of northern coastal scrub species. Still other areas had unidentifiable scrub under the wild cucumber. The blackberry type is reported herein only where observers could readily determine that blackberry is currently dominant.

Herb-Dominated

Vegetation dominated by herbaceous species at Lake Merced includes three CNPS vegetation series, Bulrush, California Annual Grassland, and Iceplant. These series and three specific herb-dominated vegetation types are defined below.

Bulrush Series

The open water at the Lake is almost continuously bordered (Photograph 10) by California bulrush (*Scirpus californicus*). In 1998, the only gaps in the bulrush (tule) ring at the Lake are at the vegetated bars between lakes and around the pumphouse at the southeastern end of South Lake.

At Lake Merced, this series consists almost entirely of bulrush, but cattails occur with the bulrushes at a few locations. The bulrush band is reported to have been a moderately wide band in 1948, a narrow, broken band in 1964, and a wide band nearly surrounding the Lake in 1987 (ENTRIX 1987). Geo/Resource (1993) reported that the band appeared narrower in 1992 than in 1987. Geo/Resource (1993) noted that the changes do not correlate in an obvious way

with lake levels. Trihey's (1998) analysis of 1996 and 1997 aerial photographs indicate that the tule band was wider and more extensive in 1996 and 1998 than in 1997. Generally, the increased width is on the upland side, rather than on the lakeside.

Water Smartweed Type

In 1998, water smartweed (*Polygonum amphibium* var. *emersum*) formed extensive stands immediately inland of the bulrush series in several locations (Photograph11). These stands generally appeared to be monotypic. However, at some locations with gentle slopes, the water smartweed extended upslope to intermingle with blackberry or other upland species.

Rush Type

Two areas at the Lake are dominated by rush (*Juncus* sp.). These areas are the landing on the northeast shore of North Lake and an area on the southeast side of the viaduct between South Lake and Impound Lake.

California Annual Grassland Series

Disturbed areas or maintained areas at various locations around the Lake are dominated by non-native annual grassland species. These species include both grasses and forbs and are frequently intermingled with iceplant (*Carpobrotus edulis*). The annual grassland series may be present as the only vegetation in open areas or may provide an understory to tree or shrub canopies. On steeper slopes, the species of the annual grassland series are often present in the coyote brush series.

Iceplant Series

The iceplant vegetation series is dominated by iceplant (hottentot-fig). This vegetation is found in many disturbed areas around the Lake. A few stands are almost entirely composed of iceplant. Many disturbed areas have a mixture of iceplant and the annual grassland vegetation described above.

Unvegetated

Unvegetated soil or paved surfaces are present at parking lots, lakeside facilities, and some access routes around Lake Merced (See Photograph 2). Bare soil was also visible at several points around the Lake where recent slope failures occurred.

Bare soils are present along the shoreline at the bar between North Lake and South Lake at a developed fishing/picnic area. The shore along the north side

of the viaduct between South Lake and Impound Lake was mostly bare soil at the Lake edge. This section of the shore receives heavy pedestrian use (See Photograph 3).

3.2 SENSITIVE PLANT SPECIES

Four plant species of concern, potentially present in this area were identified through the California Natural Diversity Data Base (CNDDB). These species are listed in Table 3-1. However, none of these species nor any similar species were seen on May 27, June 2, or June 6, 1998.

Table 3-1: Special Status Plant Species Potentially Present At Lake Merced

Common Name	Scientific Name	Status*
San Francisco lessingia	*Lessingia germanorum*	FE, CE, CNPS 1b
San Francisco Bay spineflower	*Chorizanthe cuspidata* var. *cuspidata*	FSC, CNPS 1b
Kellogg's horkelia	*Horkelia cuneata* ssp. *sericea*	FSC, CNPS 1b
San Francisco owl's-clover	*Triphysaria floribunda*	FSC, CNPS 1b
*FE = Federal endangered species; CE = California endangered species; FSC = Federal species of concern; CNPS 1b = California Native Plant Society rare species		

The wallflower photographed on the east shore of South Lake is probably San Francisco wallflower, a CNPS List 4[3] species (see Photograph 8).

3.3 INVASIVE PLANTS

An invasive exotic, iceplant (hottentot fig), is present at many locations around Lake Merced. The vegetation series dominated by this species is described on page 3-5, and its locations are shown on Plate 2.

Certain locations with extensive cover of cape ivy (*Senecio mikanioides*) were indicated in the Trihey field notes and maps, but since comprehensive species-level surveys were not part of this inventory, Cape ivy is not mapped separately on the plates. The project file will contain field data when turned over to SFPWC and SFRPD. Two occurrences of tamarisk (*Tamarix* sp.), another potentially

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[3] CNPS Category 4 = plants of limited distribution

invasive exotic species, were mapped (Photograph 12). Areas of non-native acacia are also highlighted on Plate 3.

3.4 WETLAND VEGETATION

Several of the vegetation series and types described above are considered wetland vegetation (Cowardin et al. 1979, Holland 1986, Sawyer and Keeler-Wolf 1985). These include the arroyo willow series, the bulrush series, the water smartweed type and the rush type.

CHAPTER 4 WILDLIFE

A total of 182 species are known to occur or are believed to occur within the various habitats at the Lake. Birds are the pre-dominant wildlife species associated with the Lake habitats (see Appendix B for the bird list and inhabitats). In addition to the many avian species, numerous amphibians, reptiles, and mammals also inhabit the wildlife habitats of Lake Merced. For birds, the taxonomy, sequence of the species list, scientific names, and common English names used in this report conform to the system outlined in the American Ornithologists Union *Check-list of North American Birds* (A.O.U. 1993). For other wildlife species, the names and order follow the check-list prepared by the CDFG (Laudenslayer *et al.* 1991). The status of plants and animals relative to the Endangered Species Act are based on CDFG (1998), and USFWS (1998).

4.1 WILDLIFE HABITATS

The following section presents a brief discussion of the wildlife utilization of the habitats at Lake Merced. It also provides examples of some of the representative species associated with the Lake's major habitat categories. Wildlife, especially birds, tend to respond to gross habitat characteristics, such as overall habitat structure (e.g., tree-dominated vs. herb-dominated). For various habitats whose general characteristics are similar, the associated wildlife assemblages will also be similar. For the purposes of assessment of the ecological resources at Lake Merced, some of the plant communities described individually in Chapter 3 are combined into broader habitat categories on the basis of similarities in wildlife species use, as shown on Plate 3 ("Special Status Species Habitat").

Tree-Dominated Habitats

Coniferous and Hardwood Forest

This combination of habitat types is collectively referred to as the coniferous and hardwood forest habitat. It is present along much of the upland borders of the Lake, particularly in the area of the Harding Park Golf Course (Photograph 13). Wildlife use in tree-dominated habitats depends primarily on the vertical layering and density of the tree canopy. It also depends upon the amount of understory cover from shrubs and herbs. The coniferous and hardwood forest habitat at Lake Merced provides food and shelter for a number of terrestrial wildlife species. For example, chestnut-backed chickadee (*Parus refescens*), scrub jay (*Aphelocoma coerulescens*), downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), American robin (*Turdus migratorius*), and olive-sided flycatcher (*Contopus borealis*), have been observed foraging amongst the trees at Lake Merced. In addition, the trees provide refuge, roost sites, and possibly nest sites for several of the observed raptor species, including the red-

shouldered hawk (*Buteo lineatus*) and the red-tailed hawk (*Buteo jamaicensis*). It is likely that tree swallows (*Tachycineta bicolor*) and violet-green swallows (*Tachycineta thalassina*) nest in the cavities in the trees of this habitat type. Overall, there were a total of 69 species of birds observed within these habitat types at Lake Merced.

A variety of lizards, snakes, and rodents often inhabit the understory canopy of tree-dominated habitats. Reptiles that are likely to occur within this habitat at the Lake Merced project area include garter snakes (*thamnophis* spp.), gopher snakes (*Pituophis melanoleucus*), and western fence lizards (*Sceloporus occidentalis*). With the exception of feral cats, no mammals were observed during the 1998 field visit. Although no field inventories were conducted to identify potential mammals that may use upland habitats, some mammalian species are likely to occur, such as: California ground squirrel (*Citellus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), opossum (*Didelphis marsupialis*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), rabbit (*Syvilagus* sp.), rat (*Rattus* sp.), and mice (*Peromyscus* sp.).

Arroyo Willow Riparian

This particular riparian habitat forms an ecotone between the upland and aquatic habitats at the site. Typically, many wildlife species inhabit or utilize riparian habitats because of the proximity to a water source, and because of the structural complexity of the habitat created by the multi-layer composition of trees, shrubs and herbaceous plants. The arroyo willow riparian habitat at Lake Merced provides refuge, food, water, resting, and nesting areas for a variety of avian species. For example, tree branches provide foraging, roosting, or nesting opportunities for many of the species of birds that have been observed at the Lake, which include Cooper's Hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk, bushtit (*Psaltriparus minimus*), chestnut-backed chickadee, downy woodpecker, and ash-throated flycatcher (*Myiarchus cinerascens*). The canopy of the willows also provides roosting perches for several species of waterbirds such as double-crested cormorant (*Phalacrocrax auritus),* and black-crowned night herons (*Nycticorax nycticorax*). While the treetop canopy provides habitat for various bird species, the understory layer of the habitat also supports numerous species. For example, Bewick's wren (*Thryomanes bewickii*), California towhee (*Pipilo crissalis*), and spotted towhee (*Pipilo erythrophthalmus*), which have also been observed in the Lake area, prefer the dense understory thickets for nesting and foraging. Overall, a total of 63 species of birds were identified within the arroyo willow riparian habitat at Lake Merced (Appendix B).

In addition to the diversity of avian species associated with the willow habitat at the site, numerous mammals, including Virginia opossum (*Didelphis virginiana*), and harvest mice (*Reithrodontomys megalotis*), are likely.

Shrub-Dominated Habitats

The two vegetation types, coyote brush series and blackberry type, have been combined into a single wildlife habitat referred to as shrub. This upland habitat type occurs along much of the steeper slopes surrounding Lake Merced. Depending upon the predominant plant species, the vegetative cover can be extensive, thereby providing dense habitat for many wildlife species. A total of 63 species of birds have been identified within the shrub habitat at the Lake. Allen' hummingbirds (*Selasphorus sasin*), Brewer's blackbirds (*Euphagus cyanocephalus*), and song sparrows (*Melospiza melodia*) are known to nest within this habitat. Various other passerines, including American goldfinches (*Carduelis tristis*), white-crowned sparrows (*Zonotrichia leucophrys*), and golden-crowned sparrows (*Zonotrichia atricapilla*), also utilize the Lake's shrub habitat. This habitat type is favored by ground nesters and foragers such as California quail (*Callipepla californicus*), California towhee, and spotted towhee, which take advantage of the refuge and protective cover provided by the vegetation.

As a result of the similarities in habitat features between this particular habitat type and the understory associated with both types of tree-dominated habitat at the Lake, many of the wildlife found in the shrub habitat at Lake Merced are similar to those previously mentioned for coniferous and hardwood forests, as well as arroyo willow riparian habitats.

Herb-Dominated Habitats

Marsh

Of the vegetated wildlife habitats at Lake Merced, the marsh habitat is most closely associated with the aquatic portions of the Lake. Extensive bands of bulrush and smartweed border much of the Lake, with a few isolated patches of rush also present. The bulrush/smartweed habitat represents a marsh-like habitat that is utilized by many different species throughout the year. Some of the highest number of species of birds at Lake Merced were reported within the bulrush/smartweed habitat. A total of 40 species of birds have been observed within the bulrush/smartweed habitat at Lake Merced (Photograph 14).

Wading birds, such as snowy egret (*Egretta thula*), green heron (*Butorides virescens*), and great blue heron (*Ardea herodias*) were observed foraging for small amphibians and invertebrates in the seasonally flooded smartweed. These species were also observed standing on floating or downed mats of bulrush while foraging for small fish just below the water's surface. Pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), Virginia rail (*Rallus limicola*), and sora (*Porzana carolina*), which are known to occur at the site, will nest in the protective cover of the bulrush. Other waterbirds, including mallards (*Anas platyrhynchos*), will also nest and/or take refuge in this habitat. In addition

to use of the habitat by waterbirds, the marsh vegetation provides nesting and foraging habitat for passerines including red-winged blackbirds (*Agelaius phoeniceus*), pipits (*Anthus* sp.), saltmarsh common yellowthroats (*Geothlypis trichas*, a Federal Species of Special Concern), and marsh wrens (*Cistothorus palustris*).

Amphibians, such as Pacific treefrog (*Hyla regilla*) and bullfrogs (*Rana catesbeiana*), are also associated with this habitat type and have also been identified at the Lake. The abundance of smaller amphibians, the dense vegetation, and moist/wet conditions also provide suitable habitat for various reptiles, including red-eared sliders (which have been observed at the Lake), and garter snakes (Photograph 15).

In addition to the avian, amphibian and reptilian use of the bulrush/smartweed habitat at the Lake, some mammalian use may occur. For example, muskrats (*Ondatra zibethica*) are permanent residents of marsh-like habitats where they feed primarily on emergent vegetation such as bulrushes, as well as invertebrates such as crayfish and mollusks. Other occasional mammalian visitors to the habitat also include raccoon, Virginia opossum, striped skunk, coyote and fox. However, none of these species were observed during the 1998 site visits and there has been no formal mammalian surveys.

Grassland

California Annual Grassland and Iceplant Series-dominated vegetation types are combined into the grassland wildlife habitat. The herbaceous vegetation of grassland habitat at Lake Merced provides refuge, as well as foraging and nesting habitat for numerous wildlife species. For example, Brewer's blackbirds, along with American kestrels (*Falco sparverius*), American crows (*Corvus brachyraynchos*), turkey vultures (*Cathartes aura*), and various sparrows were observed foraging within the grassland habitat surrounding the Lake.

Other wildlife taxa typically found in grassland habitat include reptiles such as gopher snakes and western fence lizards, and mammals such as black-tailed hare, striped skunk, California ground squirrel, Botta's pocket gopher, and western harvest mouse. None of these species were observed during the 1998 site visits.

Overall, the wildlife assemblage at Lake Merced associated with the grassland habitat appears similar to that previously described for the shrub-dominated habitat.

Unvegetated Shoreline Habitat

Wildlife abundance and diversity in unvegetated areas is generally greatly reduced compared to vegetated areas due to the conspicuous absence of plant

cover and lack of suitable habitat. The primary unvegetated wildlife habitat at Lake Merced is the limited amount of shoreline available in isolated locations, such as the fishing/picnic area between North and South Lakes, and adjacent to the viaduct between South and Impound Lakes. The predominant wildlife species that utilize the unvegetated shoreline areas are resting and preening waterfowl, foraging shorebirds such as killdeer (*Charadrius vociferous*) and sandpipers, and foraging passerines such as pipits and blackbirds. Within the Lake Merced area, a total of 18 species of birds are reported to be associated with the unvegetated shoreline habitat (Appendix B).

Aquatic Habitat

This particular habitat is considered to be a distinct wildlife habitat present at Lake Merced site. Waterfowl such as the American coot, mallard, cinnamon teal (*Anas cyanoptera*), northern shoveler (*Anas clypeata*), northern pintail (*Anas acuta*), gadwall (*Anas strepera*), and ruddy duck (*Oxyura jamaicensis*), are attracted to the open water, especially during late fall and winter. Gulls are known to raft and bathe in the middle of the Lake, and double-crested cormorants, terns, and osprey (*Pandion haliaetus*) have been observed foraging for fish in the open water. Various swallows, including bank swallows (*Riparia riparia*, a State threatened species) actively forage for insects in the air space over the water surface. Overall, the total number of bird species identified for the aquatic habitat at Lake Merced is 66 species.

4.2 SPECIAL STATUS ANIMAL SPECIES

The potential occurrence and distribution of special status species within the Lake Merced project area was evaluated based on a variety of information sources, including literature searches, the California Department of Fish and Game's Natural Diversity Data Base (CNDDB 1998), site-specific habitat assessment, and geographic ranges of sensitive species. Sensitive species include state and federally-listed threatened or endangered species, candidates for proposed listing, California fully-protected species and state and federal species of special concern (hereafter referred to collectively, as special status species). Appendix B summarizes the status and potential occurrence of special status species in the project area. For special status species that are either known or likely to occur in the project area, additional detailed information on each species' ecology, habitat requirements, historical occurrence, and presence in the project area is presented in Table 4-1.

A search of the CNDDB indicated that three special status bird species are known to occur within one mile of the Lake Merced project area. These species include the bank swallow (*Riparia riparia*), saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*), and the California black rail (*Laterallus jamaicensis coturniculus*). Other special status species not reported in the CNDDB, but documented as occurring at Lake Merced include the American Peregrine Falcon (*Falco peregrinus anatum*).

In addition, based on potential habitat and geographic range, three other special status animals were identified as potentially occurring at Lake Merced. These species include two reptiles species, the San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) and the western pond turtle (*Clemmys marmorata*), and one amphibian, the California red-legged frog (*Rana aurora draytonii*). A printout of the CNDDB record of the special status species occurring with one mile of the project area are presented in Appendix B. The potential occurrence of all these species in the project area and their current listed status is discussed below.

Table 4-1: Lake Merced Plant Communities, Habitat Types, and Associated Special Status Animal Species

Plant Community	Habitat Type	Associated Special Status Species
Monterey Pine, Monterey Cypress, Eucalyptus, Coast Live Oak, & Acacia	Coniferous and Hardwood Forest	American peregrine falcon (*Falco peregrinus anatum)*
Arroyo Willow Riparian Woodland	Arroyo Willow Riparian Woodland	Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)
Coyote Brush, Blackberry	Shrub	none
California Annual Grassland, Iceplant	Grassland	none
Bulrush, Water Smartweed, and Rush	Freshwater Marsh	California black rail (*Laterallus jamaicensis conturniculus*),* Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*), American peregrine falcon (*Falco peregrinus anatum)*
Aquatic	Marsh/Open water	Bank swallow (*Riparia riparia*), American peregrine falcon (*Falco peregrinus anatum)*

- No recent formal surveys to document presence, but species was previously noted here

The **bank swallow** is a state listed threatened species (CDFG 1998). Bank swallows are a migratory species that winters in South America and breeds in much of North America. Apparently the species has never been abundant in California, but it has nested historically from the upper Sacramento Valley and along coast ranges to southern California. It has also been eliminated from many coastal locations, flood control projects, and California rivers due to urbanization, and an increase of human presence.

In order to nest, bank swallows require vertical cliffs or banks that contain sandy or loamy layers in which they can dig nesting burrows. Although bank swallows are known to nest within one mile of Lake Merced on coastal cliffs near the Fort Foston area, there is no nesting habitat for this species in the project area. However, they are seasonal inhabitants to the Lake area and are known to forage over open water and marsh habitats.

The **California black rail** is classified as a species of special concern by the U.S. Fish and Wildlife Service and is designated as threatened by the California Department of Fish and Game (CDFG 1998). It is a resident species in the marshes of the San Francisco Bay area and the Sacramento-San Joaquin Delta wetlands. It is a secretive species, primarily inhabiting saltwater marshes, but

black rails have been observed in brackish and freshwater marshes. In salt marshes, black rails are found in areas with pickleweed or a mixture of pickleweed and bulrushes. In freshwater marshes, this species is found in dense stands of cattails, bulrushes, and saltgrass. Their nests consist of small sticks built at ground level or elevated slightly in vegetation. According to the CNDDB, the last recorded sighting in the Lake Merced area occurred in 1937, but more recent sightings have been documented by the Golden Gate Audubon Society (Murphy 1997).

The **Saltmarsh common yellowthroat** is a federal species of concern (CDFG 1998) and a year-round resident in the San Francisco Bay Area. The saltmarsh common yellowthroat breeds and nests in spring and summer. Nests have been found in riparian woodland and freshwater marsh habitat along Lake Merced. In 1985, 14 breeding pairs were observed along the shore of Lake Merced (ENTRIX 1987). The birds were observed nesting in bands of tules along the Lake shore and in willow thickets on the banks above the Lake (ENTRIX 1987).

The **California clapper rail** is a federally-listed and a state listed endangered species (CDFG 1998). It primarily inhabits saltwater tidal marshes of pickleweed and cordgrass. This species is known to occur on the coast from Marin County to San Diego County. The California clapper rail is currently found around northern and southern San Francisco and San Pablo Bays. A census conducted in 1975 estimated the San Francisco Bay clapper rail population to be over 4000. However, it now appears that fewer than 500 San Francisco Bay clapper rails exist within the area (Small 1994). A single sighting of the California clapper rail documented by Dan Murphy of the Golden Gate Audobon Society is believed to be a vagrant sighting.

The **American peregrine falcon** (Falco peregrinus) is a federal and state-listed endangered species (CDFG 1998). It nests primarily on cliffs, ridges, and rocky areas within hunting range of avian prey. Its preferred nesting locations include offshore island cliffs, coastal sea cliffs, and near large shallow interior lakes. Some of the American peregrine falcon preferred prey includes rock doves and European starlings. Its range in California is widespread and they are dispersed coastally from Del Norte County south to San Diego County. There have been recent documented sightings of the American peregrine falcon in the Lake Merced area (Murphy 1997). Their probable use of the Lake Merced habitats would be for resting and foraging.

The **California red-legged frog** is a California species of special concern and a federally-threatened species (CDFG 1998). Currently, this subspecies generally only occurs in the coastal portions of its historic range; apparently it is extinct in the valley and foothills and in most of southern California south of Ventura County. California red-legged frogs are usually confined to aquatic habitats such as ponds, lakes, or streams. The habitat features usually include deep, still or slow-moving water primarily in areas having pools approximately 1m deep. Adjacent habitat typically includes dense emergent or riparian vegetation, including arroyo willow, cattails, and bulrushes. In many areas, including Lake Merced, the primary cause of decline or extirpation is predation by exotic aquatic predators. In Lake Merced, these predators include bass and bullfrog, that could potentially feed on tadpoles and frogs. Although Lake Merced is within the range of the California red-legged frog, the known presence of bass and recent field observations of bullfrog in Lake Merced suggests extirpation of the California red-legged frog from the project area. The last known sighting of the California red-legged frog from the Lake Merced area occurred prior to 1966 (CNDDB 1998). However, no recent formal survey for this species have been conducted. Therefore the presence or absence of red-legged frogs at the Lake is currently unknown.

The **San Francisco Garter Snake** is a state and federally-listed endangered species (CDFG 1998). The historic range of this subspecies of the common garter snake extends from the San Francisco County line south through the Santa Cruz mountains to Point Ano Nuevo. This species is not expected to occur in the project area because Lake Merced is slightly north of the currently known range, the Lake lacks the upland habitat required by the species, there are no known records of this species occurring in Lake Merced, and bass and bullfrogs are known predators of various snake species (including the San Francisco garter snake). However, surveys have not been conducted at Lake Merced for the San Francisco garter snake.

The **Western Pond Turtle** is a California species of special concern (CDFG 1998). This species prefers areas of permanent or nearly permanent, still or slow-moving water, with partially exposed logs or ledges for basking. Habitat requirements of the western pond turtle also include a terrestrial component, primarily for oviposition, over-wintering, occasional seasonal use, and overland dispersal. Lake Merced contains aquatic habitat features conducive to supporting the western pond turtle, however, there are no known records of this species occurring at the site. On the site visits conducted by Trihey in May and June of 1998, there were no Western Pond Turtles observed. However, the introduced red-slider was recorded.

CHAPTER 5 FISHERIES

Trihey reviewed data about the fishery resources in Lake Merced from California Department of Fish and Game (CDFG) files, as well as files from the City and County. Additional information about current stocking practices and recreational fishing in the Lake was obtained from the Merced Boating and Fishing Company.

Lake Merced is presently the only freshwater fishing opportunity in the City and County of San Francisco. The Lake was originally developed for a drinking water supply in the 1870's but opened to fishing in 1939 after the development of Hetch Hetchy water supply system. To enhance fishing opportunities at that time, the California Fish and Game Commission stocked the Lake with largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and Sacramento perch (*Archoplites interruptus*).

The fishery in Lake Merced was considered poor to fair from 1939 to 1944. As a result, rainbow trout (*Oncorhynchus mykiss*) were introduced into North Lake during 1944. From 1944 to 1947, fingerlings and catchable size trout were introduced into North Lake. However, only a mediocre trout fishery developed from these efforts. Competition from non-game fish was blamed for the poor trout fishery. In 1949 and 1952, both the North and South Lakes were treated with rotenone to eliminate non-game fish. Beginning in 1953, fingerling and later, catchable size, rainbow trout were planted in both lakes regularly. Today, rainbow trout and channel catfish (*Ictalurus punctatus*) are planted in both lakes on a regular basis under a cooperative program between CDFG and the SFPRD.

5.1 FISH SPECIES INVENTORY

Over approximately forty years of CDFG studies (1949-1989) a total of 21 species of fish were reported from Lake Merced (Table 5-1).

Large mouth bass, stickleback, white catfish, and rainbow trout were the only fish species found in the Lake in 1949, 1962-64, and in the 1970's. Of these species, only the stickleback and rainbow trout were also found in 1989. Tule perch, Sacramento sucker, and prickly sculpin have only been not reported from Lake Merced since 1975. Conversely, species such as the black and brown bullhead, Sacramento perch, hitch, golden shiner, and black crappie had been reported from Lake Merced prior to the 1970's but were not found in subsequent studies. It is possible that all of these species may have been present because different techniques with varying effectiveness for certain fish species were used to sample fish during 1962-64, 1975-77, and 1989.

Table 5-1: CDFG Fish Species Observations for Lake Merced (1949-1989)

Fish Family	Species (common name)	Status of Species	Study Date and Method				
			1949 Rotenone Treatment	1962-64 Rotenone Treatments	1962 Gillnet Sampling	1975-77, 1979 Electro-fishing	1989 Gillnet Sampling
Cool Water Fisheries							
Salmonidae	rainbow trout	N	X	X		X	X
	kokanee salmon	i			X		
Cottidae	prickly sculpin	N*				X	X
Warm Water Fisheries							
Catastomidae	Sacramento sucker	i				X	
Centrarchidae	large mouth bass	i	X	X		X	
	green sunfish	N*		X		X	
	Sacramento perch	N*	X				
	bluegill	i	X	X			
	black crappie	i			X		
Cyprinidae	hitch	N*	X	X			
	carp	i	X			X	
	goldfish	i		X		X	
	golden shiner	i		X			
	hardhead	i		X			X
	Sacramento blackfish	N*	X	X			
Embiotocidae	tule perch	N*				X	X
Gasterosteidae	three spine stickleback	N*	X	X		X	X
Ictaluridae	white catfish	i	X	X		X	
	brown bullhead	i		X			
	black bullhead	i		X			
	channel catfish	i					X

Source: CDFG site files (provided by Margaret Roper), compiled by Trihey & Associates, 1998.

N California native fish species that may have historically occupied habitat like Lake Merced.

N* California native fish species but would not occupy habitat like Lake Merced.

i Species of fish introduced to California.

Although the Lake is primarily managed for rainbow trout, addtional fish species have been intentionally introduced into the Lake, including muskellunge (1893), kokanee salmon (1961-62), coho salmon (1982), eastern brook trout (1957-58, 1965, 1977), channel catfish (1994-1998), and black crappie, large mouth bass, sunfish, and catfish from Anderson Reservoir in 1983. Fishermen and other members of the public have likely introduced additional fish species into the Lake as well. However, not all of the species introduced into the Lake were able to establishment permanent populations.

Of the 21 species reported from Lake Merced by CDFG studies as the past 40 years, only 14 have the potential to establish permanent populations in the Lake. All of these species are warm water fish. Cold water fish and all species requiring gravel or riffle habitats for spawning can not successfully reproduce in Lake Merced. Although these species can not reproduce in Lake Merced, most can survive and grow in the Lake. Species such as rainbow trout and channel catfish that can not reproduce in the Lake can support a sport fishery, if their populations are artificially maintained.

5.2 COOL WATER FISHERIES

Rainbow Trout

Rainbow trout are stocked in the Lake on a regular basis, and the Lake provides a good habitat for resident rainbow trout. Yearly variation in water temperatures falls with in the range of trout tolerances. Invertebrates and other fish provide food for trout to grow and develop. Most rainbow trout mature in their second or third year and can live to approximately seven years (Moyle 1976). However, the lack of appropriate spawning habitat in Lake Merced limits trout reproduction and requires that the population be artificially maintained. Because of the lack of a connection to the ocean, steelhead (anadromous rainbow trout) do not currently occur and are not expected to occur in Lake Merced.

Prickly sculpin

The lack of appropriate spawning conditions limits the ability of prickly sculpin to successfully reproduce and maintain a population in Lake Merced. Prickly sculpin occupy a wide range of bottom habitats (Moyle 1976). These fish can be found in streams ranging from small, cold, and clear to large, warm, and turbid. They feed primarily on large benthic invertebrates, although other aquatic invertebrates and small fish can also be taken. The maximum size is about 20 m standard length (SL)[4] and they have been found to live more than seven years.

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[4] SL = Standard Length, measured from the fish's nose to the point where its tail is attached;
FL = Fork Length, measured from the fish's nose to the shortest part of its tail (Forked); and
TL = Total Length, measured from the fish's nose to the end of its tail.

5.3 WARM WATER FISHERIES

Sacramento Sucker

As appropriate spawning habitat for Sacramento suckers is not available in Lake Merced, these fish are unlikely permanent residents. Sacramento sucker are most often found in the pools of clear, cool to warm streams or in lakes and reservoirs (Moyle 1976). They are usually associated with native minnows and can be found with trout. Suckers are most active at night, when they feed on algae, detritus, and bottom dwelling invertebrates. Growth is highly variable and the percentage of larger fish varies among populations. Sacramento suckers can be fairly long lived, over ten years, and are commonly found up to 60 cm SL.

Largemouth Bass

Conditions in Lake Merced are favorable for largemouth bass growth and reproduction, making the existence of a permanent population in the Lake likely. Largemouth bass are common in warm, clear, calm waters with beds of aquatic macrophytes. Farm ponds, lakes, reservoirs, sloughs, and river backwaters are typical largemouth bass habitats (Moyle 1976). Adults are solitary, feeding on large invertebrates and other fish. Young largemouth bass congregate in schools, feeding on smaller invertebrates. Both young and older bass are active during the day and night. Because these fish are such voracious predators, they are a popular gamefish in California and elsewhere. Largemouth bass typically spawn after reaching 2 to 3 years in age and a size of 18 to 21 cm TL. The spawning season usually runs from April to June, starting when water temperatures reach 14 to 16°C. Males build nests in shallow areas with sand, gravel, or debris-filled bottoms, defending the nest from predators until the eggs hatch.

Green Sunfish

Temperature and habitat conditions in Lake Merced are favorable for successful growth and development of green sunfish. Green sunfish are common residents of small, warm water streams, ponds, and lake margins with muddy bottoms and beds of aquatic macrophytes (Moyle 1976). These fish are tolerant of temperatures greater than 36°C, oxygen concentrations less than 3 ppm, and alkalinities greater than 2,000 mg/l. They are aggressive and territorial, opportunistically feeding on large invertebrates and other fish. Green sunfish can first reproduce at a small size, 5 to 7 cm SL, usually at the beginning of their third year. Spawning usually occurs from May to August when water temperatures exceed 19°C. Males construct nests in gravel bottomed areas or in areas under overhanging branches or other cover. In the wild, green sunfish often hybridize with bluegill, pumpkinseed, warmouth, and other species of co-occurring sunfish.

Bluegill

Although bluegill have not been documented from Lake Merced since the 1960's, conditions in the Lake are favorable for the growth and reproduction of these fish. Bluegill can survive and reproduce in a wide variety of habitats and are thus one of the most abundant fish species in California (Moyle 1976). They are most successful, however, in warm, shallow lakes, reservoirs, ponds, and sloughs at low altitudes. Areas of rooted aquatic vegetation, less than 5m deep, with bottoms of silt, sand, or gravel are the preferred habitat of this species. These fish are highly opportunistic omnivores, ingesting what food items are most abundant in their habitat. Spawning typically occurs in the spring when water temperatures range from 18 to 21°C. Males excavate nests in gravel, sand, or mud bottomed areas, and defend this nest from other males and predators. These fish are very prolific, producing an average of 2,000 to 18,000 young per nest.

Black Crappie

Although black crappie were found in Lake Merced only during a 1962 gillnet study, conditions in the Lake should be able to support a black crappie population. Black crappie are common residents of large, warm, clear lakes and reservoirs with large beds of aquatic macrophytes (Moyle 1976). These fish forage mainly during the evenings and early mornings in offshore, open water habitats. Young black crappie eat primarily zooplankton and small fly larvae, while older fish eat a larger variety of aquatic insects. Black crappie mature in their second or third year after attaining a size of 10 to 20 cm TL. Spawning is typically from March to April when water temperatures are higher than 14 to 17°C. During this period, males excavate nests in shallow water near beds of aquatic macrophytes, defending the eggs and newly hatched fry from predators.

Hitch

Hitch may maintain a self-sustaining population in Lake Merced. Hitch are minnows that are found in warm lakes and ponds and sloughs or slow moving stretches of river (Moyle 1976). Hitch are omnivores in open-water and on the surface. Hitch grow to about 30 cm SL, mature in their first through third years, and live past five years. They spawn between March and July.

Carp

Conditions in Lake Merced are favorable for growth and successful spawning of carp. Carp are primarily found in warm, eutrophic, silty-bottomed waters with heavy growths of aquatic vegetation (Moyle 1976). However, they have been found in some trout streams and cold-water reservoirs as well. These fish can survive under a wide range of conditions, including high turbidity, sudden temperature changes, and low oxygen concentrations. Carp forage along the

bottom in shallow water, eating vegetation and invertebrates. Their foraging behavior uproots aquatic plants and increases the turbidity of the water, making carp an undesirable species in many areas. Spawning occurs in the spring and early summer in weedy areas, after water temperatures exceed 15°C.

Goldfish

Goldfish are likely able to grow and successfully reproduce in Lake Merced, because of their ability to persist in a wide range of environmental conditions. Goldfish are common in warm, often poorly oxygenated waters with dense growths of aquatic vegetation (Moyle 1976). They have been reported to survive water temperatures from 0 to 41°C. These fish are primarily open water foragers, feeding on phytoplankton and zooplankton. Detritus, algae, and occasionally invertebrates are often taken as well. Goldfish mature in their second or third year, spawning first in April or May when water temperatures range from 15 to 23°C. Each season, a goldfish can spawn several times, laying up to 4,000 eggs each time. Spawning usually takes place over submerged vegetation on sunny days.

Golden Shiner

Conditions in Lake Merced should be able to support a self-sustaining population of golden shiner. Introductions by anglers at the Lake may also contribute to the numbers of golden shiner in Lake Merced. Golden shiner are often found in warm ponds, lakes, and sloughs containing dense aquatic vegetation (Moyle 1976). They persist in these environments because they can tolerate high temperatures (as high as 35°C) and low oxygen levels. These fish are primarily open water foragers, feeding mainly on zooplankton. Spawning generally occurs from March to August, when water temperatures reach approximately 20°C. Golden shiner spawn in schools, usually over submerged vegetation. Anglers often use these fish as bait, resulting in the accidental introduction of golden shiner into numerous lakes, ponds, and reservoirs.

Hardhead

Although hardhead were reported from Lake Merced during the 1960's and in 1989, these fish were not likely representative of a permanent population (and may have been Sacramento blackfish mistaken as hardhead). The lack of appropriate habitat and spawning conditions make successful reproduction and establishment of this species in Lake Merced unlikely. Hardhead are common residents of undisturbed, warm, clear stream pools (Moyle 1976). Occasionally these fish are found in reservoirs, but usually only a few years after initial construction. They are primarily bottom dwelling fish, eating mainly aquatic insect larvae, small snails, and plants.

Sacramento Blackfish

Blackfish should be able to grow and successfully reproduce under the current conditions in Lake Merced. Sacramento blackfish are minnows that are most abundant in warm, shallow, slow velocity areas of streams and are common in lakes (Moyle 1976). They can tolerate turbid water and are often found in higher abundances in turbid areas. Blackfish primarily forage in open water habitats, filter feeding on algae and zooplankton. These fish generally live four or five years, reaching up to 50 cm fork length (FL). Blackfish mature in their second or third year and spawn between April and July in shallow areas with thick aquatic plant growth.

Tule Perch

Successful growth and development of tule perch is possible under the present conditions in Lake Merced. Tule perch are small fish that occupy a wide range of habitats in large, low-elevation streams (Moyle 1976). They seldom live past five years of age or exceed 15 cm SL. Despite their small size, they can be found in swift water areas in eddies behind rocks or vegetation. They can also be found along edges or in backwaters and are often associated with emergent vegetation or undercut banks. They feed primarily on small, hard-shelled invertebrates. Males often defend a territory, presumably to attract females for mating. Mating takes place between July and September and the female stores the sperm until January, when fertilization occurs. When food is abundant in May and June, the young are born.

Three-spine Stickleback

Conditions in Lake Merced provide suitable habitat for the growth, development, and reproduction of three-spine sticklebacks. Three-spine stickleback are very small fish that inhabit clear, quiet-water areas in ponds and streams (Moyle 1976). They can be found in cool water streams, but are usually found in warmer backwater areas in those streams. The largest fish grow to 8 cm TL and most only live one year. They feed primarily on bottom or plant dwelling organisms. Beginning in April through July, sticklebacks move into breeding areas. Males generally turn reddish in color, set up territories, and begin nest construction. Once the nest is complete, a female enters the nest and deposits her eggs, which the male fertilizes. The male then tends the eggs by fanning the nest with his pectoral fins. Once the eggs hatch, the male guards the school of fry for a short period.

White Catfish

Breeding behaviors and requirements are similar to those of the bullheads, making white catfish a possible permanent resident of Lake Merced. White catfish are adapted to sluggish areas of large, coastal streams but commonly

inhabit large, warmwater lakes, reservoirs, and the occasional farm pond (Moyle 1976). During the spring and early summer, these fish congregate in waters 3 to 10 m deep, avoiding heavy beds of aquatic macrophytes. In the summer they move to deeper waters with temperatures greater than 21°C. They are carnivorous benthic feeders, occasionally swimming up from the bottom to forage for planktivorous fish. Spawning typically first occurs when the fish are 20 to 21 cm FL (3 to 4 years old) during the months of June and July when water temperatures are greater than 21°C.

Brown Bullhead

The food habits and reproductive behaviors of brown bullheads are similar to black bullheads and brown bullhead should be able to maintain a self-sustaining population in Lake Merced. Brown bullhead can adapt to a wide variety of aquatic environments. However, they prefer the deep end of the littoral zone (2 to 5 m), aquatic macrophyte beds, and muddy or sandy bottomed areas of large bodies of water (Moyle 1976). Although they can inhabit water temperatures from 0 to 37°C, their optimal temperature range for growth is from 20 to 35°C.

Black Bullhead

Although black bullhead have not been reported from Lake Merced since the 1960's, these fish should be able to grow and reproduce. Black bullhead prefer ponds, small lakes, river backwaters, and small stream pools with warm and turbid water, muddy bottoms, slow currents, and a lack of flow to successfully reproduce (Moyle 1976). These fish are highly social and are often congregate loosely in schools. Young-of-year black bullheads swim around during the day in tight schools, feeding mainly at dusk and dawn. Adult bullheads feed mainly during the night and are relatively inactive during the daytime. At all sizes these fishes are omnivorous, feeding mainly on benthic aquatic insect larvae, crustaceans, molluscs, and occasionally other fish. The maximum size of these fish is approximately 46 cm TL. Spawning generally occurs in June and July when water temperatures exceed 20°C. Females construct shallow nests where the eggs are laid are fanned continuously by either the male or female until hatching.

Channel Catfish

The population of channel catfish in Lake Merced, likely requires artificial supplementation due to the lack of suitable spawning sites and spawning temperatures. Channel catfish are most often found in the main channels of large streams but can live in a wide variety of aquatic habitats (Moyle 1976). These fish can tolerate oxygen concentrations as low as 1 to 2 ppm, temperatures of 36 to 38°C, and moderately saline waters. However, their optimal conditions are oxygen concentrations above 3 ppm and temperatures

above 21°C. In California, channel catfish generally do not exceed 53 cm TL (1.5 kg) or ten years of age (Moyle, 1976). These fish are omnivorous, consuming primarily aquatic insect larvae when young and larger crustaceans and fish when older. The optimal temperature for spawning is 27 to 28°C, a temperature not typical for Lake Merced.

5.4 SPECIAL STATUS SPECIES

None of the fish species in Table 5-1 or discussed above, are special status species. The only special status fish species ever associated with Lake Merced was the tidewater gobi (*Eucyclogobius newberryi*). The gobi is a federally endangered and state threatened species; It is a small, fish found primarily in lagoons created by small coastal streams. However, when Lake Merced was developed into a reservoir in the 1800s, its tidal connection to the ocean was closed. Because the gobi has not been found in the Lake since then, and all potential sources of natural colonization for this species have been removed, tidewater gobies are not expected to occur in Lake Merced.

5.5 FISHERIES SUMMARY

Of the twenty-one species reported to occur in Lake Merced by CDFG studies, only fourteen have the potential to exist as permanent populations in the Lake. All of these species are warm water fish: largemouth bass, green sunfish, bluegill, black crappie, carp, goldfish, golden shiner, black bullhead, brown bullhead, white catfish, three-spine stickleback, hitch, blackfish, and tule perch. Cold water fish and species requiring gravel or riffle habitats for spawning can not successfully reproduce in Lake Merced. However, even the species that can not reproduce in Lake Merced can generally survive and grow in the Lake. Sport fishery species such as rainbow trout and channel catfish that can not reproduce in the Lake need to be artificially maintained to sustain long-term availability. None of the reported species have special status under either State or the Federal Endangered Species Act.

CHAPTER 6 RECOMMENDATIONS FOR LAKE MERCED RESOURCE INVENTORY

6.1 INTRODUCTION

The 1998 Baseline Inventory provides a compiled natural resources inventory for Lake Merced, serving as an important initial step in future management decisions. This inventory builds upon the results of prior studies, and establishes an organizational framework for a working resources inventory to be maintained by SFPUC and SFRPD. The 1998 Baseline Inventory integrates mapped data of both the Lake margins and upland areas into a computerized format that is intended to be supplemented over the coming years. While the 1998 field data was limited to a single season, the mapping procedures and recording methods can be readily reproduced in subsequent studies. SFRPD anticipates working with individuals and organizations in the community, such as the California Native Plant Society-Yerba Buena Chapter, Friends of Lake Merced, and Golden Gate Audubon Society to continue the development of the Lake Merced natural resources database.

Trihey offers the recommended monitoring concepts described below for each of the major biological resource areas. These concepts have been developed to blend scientific data collection methods with community-based approaches and provide a useful, cost-efficient working database. All of the concepts involve the participation of volunteer personnel, even if professional staff may be directing or managing efforts. Therefore, it will be important to have data regarding each observer's experience level and a certainty rating included in all data records.

6.2 VEGETATION MONITORING RECOMMENDATIONS

Monitoring the distribution of invasive exotic plant species should be encouraged, to maintain current information on areas where these species may be encroaching on the remaining stands of native vegetation. This would facilitate control efforts focused on the protection of existing native populations. Control efforts on invasive plant populations should be recorded and mapped, to document progress and/or highlight areas of concern that may require repeated treatments or study of future re-invasion. Floristic inventories could be conducted in the stands of native scrub vegetation to provide information for management decisions. These data would be useful to determine where the control of less invasive, yet exotic, plant species may be desired to enhance conditions for native species.

Since the native scrub vegetation is primarily located on steep, erodible, or unstable slopes, personnel conducting monitoring and restoration activities should be trained to reduce potential impacts from their presence, and on-site activities should be scheduled to avoid periods when the slopes are saturated and prone to failure.

6.3 WILDLIFE MONITORING RECOMMENDATIONS

Reporting protocols being developed by SFRPD for use throughout the City should be integrated in SFPUC programs at the Lake. Monitoring of seasonal bird use in all habitat types around the Lake should be emphasized to provide information to guide management decisions. The data collected would be important for documenting the status of bird species use of the Lake Merced area. Observations should indicate the species, gender, number observed, habitat associations, behavior, season, date and time. Data collected can help determine seasonal variation in use and assist in scheduling restoration activities to reduce potential disturbance to breeding birds. The herpetological data set should be expanded by use of observations, including photographic documentation of species presence and habitat associations during various seasons. Invertebrate studies could provide valuable information on available food supply to supplement vegetation-related data on habitat requirements.

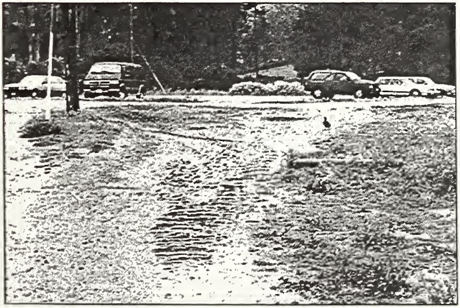
Persons monitoring birds, reptiles, and amphibians or participating in vegetation monitoring and restoration should be encouraged to report mammalian activities. This would provide a minimally intrusive, cost-effective means of establishing a larger data set on mammalian use of the Lake environs.

6.4 FISHERIES MONITORING RECOMMENDATIONS

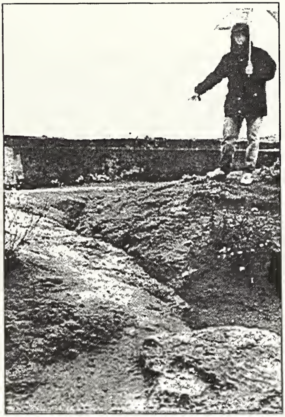
Lake Merced has been only occasionally sampled - on average about once every ten years since the late 1940s. Basic information on fish species occurrence and distribution in the Lake is unavailable due to the long periods between sampling and the variety of methods used. This limits the ability to formulate Lake management plans. We recommend that the City begin a three-year monitoring program, directed at defining the present habitat conditions and fish population in the Lake. Fish sampling should be conducted annually for three years, along with seasonal water quality profiles (i.e., temperature, dissolved oxygen, conductivity) and bottom sediment samples at selected locations that represent the range of water depths and conditions. Such a sampling program could be implemented using a combination of skilled professionals and trained volunteers. These data would provide basic information from which the City could begin to make management decisions regarding the fishery.

CHAPTER 7 PHOTOGRAPHS

PHOTOGRAPH 1. Top of soil fall on the north shore of East Lake. The heavy and long-duration precipitation of winter 1997/98 had contributed to recent activation of slope failures along some of the steeper banks of East and North Lakes



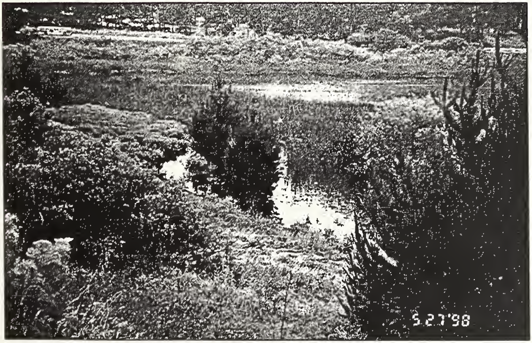
PHOTOGRAPH 2. Heavy foot traffic area by Impound Lake, denuded of vegetation and experiencing water erosion from sheet flow



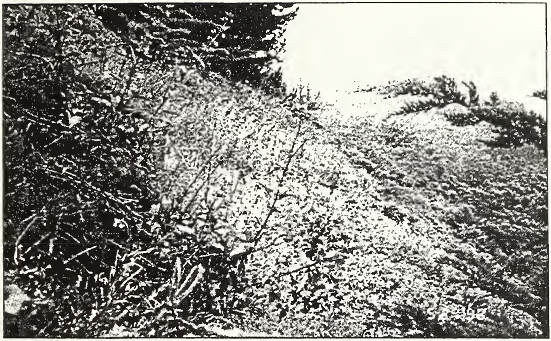
PHOTOGRAPH 3. Example of gully erosion in area of heavy foot traffic along causeway between Impound Lake and South Lake

PHOTOGRAPH 4. Steeply sloped shorelines of East Lake representative of areas prone to slope failure, rather than simple surface soil erosion.

PHOTOGRAPH 5. Arroyo willow series on northeast shore of East Lake.

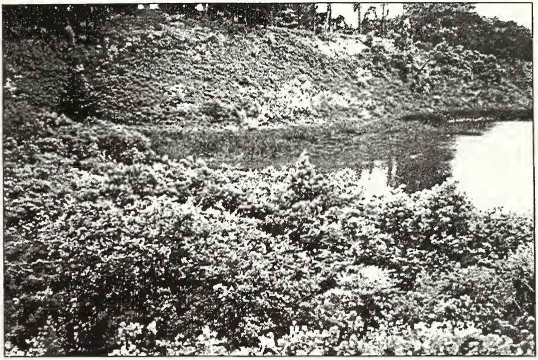


PHOTOGRAPH 6. Young pine trees in standing water along east side of Impound Lake, indicating that the water level was lower for several years prior to the winter of 1997/98.

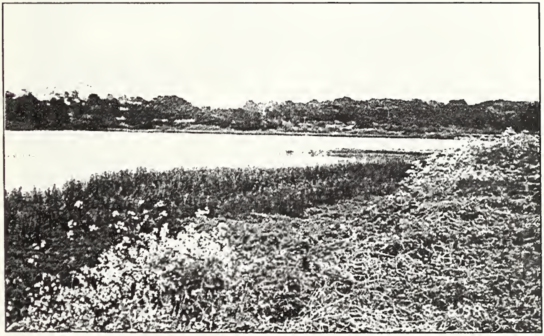


PHOTOGRAPH 7. Coyote brush series on east shore of South Lake.

PHOTOGRAPH 8. Wallflower within coyote brush series, on east shore of South Lake.

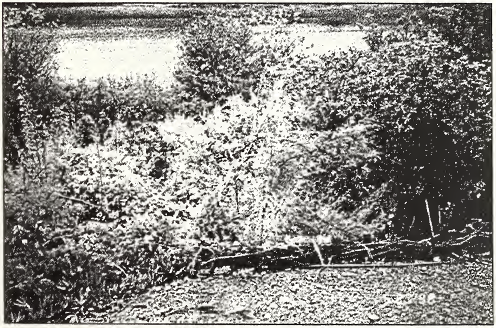


PHOTOGRAPH 9. Coyote brush/blackberry scrub along south shore of East Lake



PHOTOGRAPH 10. Bulrush series along west side of South Lake, bordering open water.

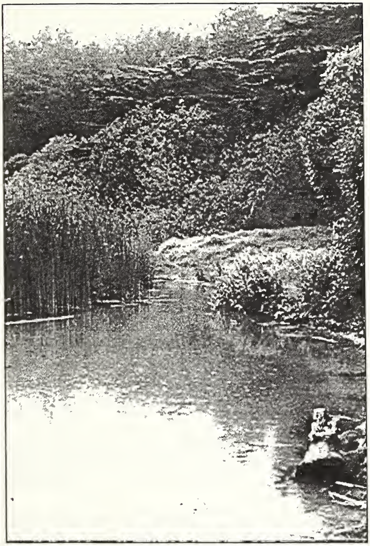
PHOTOGRAPH 11. Water smartweed on upland side of bulrush series along west side of South Lake.



PHOTOGRAPH 12. Tamarisk along western shore of Impound Lake. Tamarisk is an exotic species.

PHOTOGRAPH 13. Forest habitat along the margins of the upland terraces around Lake Merced.

PHOTOGRAPH 14. Marsh habitat along shore of South Lake between open water and upland shrub and forest habitat.



PHOTOGRAPH 15. Interface of marsh, open water and upland habitat along South Lake, suitable for reptiles and amphibians.

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LITERATURE CITED

Allen, J. T. 1964. Rotenone treatment project North Lake Merced, San Francisco County, 1962. California Department of Fish and Game. Inland Fisheries regional report.

Barbour, M. G., and J. Major, editors. 1988. Terrestrial vegetation of California. Second edition: California Native Plant Society. 1030 p.

California Department of Fish and Game. Inland Fisheries administrative report number 58-14.

California Department of Fish and Game. 1998. *List of Special Animals in California,* revised March 1998. The Resource Agency. California Department of Fish and Game. Sacramento, CA

California Department of Fish and Game. 1979. Memorandum from the Department of Fish and Game. Detail of fish population sampling.

Cowardin, L. M., V. Carter, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U. S. Fish and Wildlife Service OBS-79/31.

ENTRIX, Inc. 1988. Bathymetric survey of Lake Merced. 18 pp. prepared for Recreation and Park Department, City and County of San Francisco.

ENTRIX, Inc. 1987. Preliminary inventory of natural resources of Lake Merced. Unpublished report prepared for Recreation and Park Department, City and County of San Francisco.

Fisher, C. K. 1958. Proposed changes in the trout management program at Lake Merced, San Francisco

Geo/Resource Consultants, Inc. 1993. Lake Merced water resource planning study.

Geo/Resource Consultants, Inc. 1993. Lake Merced water resource planning study appendices.

Holland R. F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Sacramento: California Department of Fish and Game. 156 p.

Holloran, P. October 24, 1997. Letter to Lisa Wayne of Recreation and Park Department, City and County of San Francisco.

Kurz, A. 1998. Letters to Andria Pomponi, CDM, an account of fishes and terrestrial vertebrates in and around Lake Merced and an account of reptiles and amphibians seen at Lake Merced

Kurz, A. 1991. Observations of native resident vertebrates of the gulley east of Lake Merced.

Kurz, A. 1983. Native wildlife of the west of Twin Peaks Districts and the Lake Merced area.

McGowan, M. F. and M. Vasey. 1997. Lake Merced stewardship project. San Francisco State University, San Francisco. 32 pp.

Murphy 1998. Personal communication from Dan Murphy. Unpublished bird species list from Jan. 1 - Dec. 31, 1997. Golden Gate Audubon Society.

Murphy 1997.Personal cummunication from Lisa Wayne of the San Francisco Department of Recreation and Park. Table of bird species reported from Lake Merced.

Richer, C. (ed) 1985. *San Francisco Pennisula Bird Watching.* Sequoia Audubon Society. San Mateo, CA.

San Francisco Public Utilities Commission and San Francisco Recreation and Park Department. October 1997. Lake Merced comprehensive management plan. 12 pp.

San Francisco Water Department. 1997. Lake Merced water quality data.

Sawyer J. O., and T. Keeler-Wolf. 1995. A manual of California vegetation. Sacramento: California Native Plant Society. 471 p.

Scholz, D. E. 1989. Measuring park user satisfaction: a survey at Lake Merced. M.S. thesis. University of California, Berkeley.

Small, A. 1994. *California Birds, Their Status and Distribution.* Ibis Publishing Company. Vista, CA.

Strohschein, W. E. 1964. The 1964 chemical treatment of North Lake Merced San Francisco County. Inland Fisheries regional report.

U.S. Department of Agriculture, Bureau of Soils. 1917. Reconnaissance Soil Survey of the San Francisco Bay Region California. Washington, D.C.

U.S. Department of Agriculture, Soil Conservation Service. 1991. Soil Survey of San Mateo County, Eastern Part, and San Francisco County, California. Washington, D.C.

U.S. Fish and Wildlife Service. 1985. San Francisco South, California. Map prepared by National Wetlands Inventory.

U.S. Geological Survey. September 28, 1988. Lake Merced fact sheet.

U.S. Geological Survey. Preliminary Geologic Map of Marin and San Francisco counties and Parts of Alameda, Contra Costa, and Sonoma counties, California. M.C. Blake, Jr., J.A. Bartow, V.A. Frizzell, Jr, J. Scholcker, D. Sorg, C.M. Wentworth, and R.H. Wright. United States Geological Survey in cooperation with the Department of Housing and Urban Development. 1974.

APPENDIX A

VEGETATION

Three site visits were made by Trihey to Lake Merced on May 27, June 2 , and June 6, 1998. Vegetation types were marked on copies of large-scale aerial photographs based on visual observations. Additional written field notes were made of species present. Locations of large occurrences of invasive exotics were also noted. A Global Positioning System rover unit was used to identify selected locations. Lake Merced was photographed from several points to provide visual documentation of the vegetation in 1998. Previous reports (ENTRIX 1987, Geo/Resources 1993, Holloran 1997) were reviewed to further determine vegetation types and species of interest. After final choices were made for vegetation types to be mapped, the field data were transferred to copies of aerial photographs to be digitized into a GIS system (Plate 2). Locations of four species were recorded with a Global Positioning System unit and mapped to provide relational data for GIS mapping. The features located with GPS data are a madrone tree on the west shore of South Lake, a red elderberry tree on the west shore of South Lake, a willow thicket on the east shore of South Lake, and the tamarisk occurrence on the west shore of Impound Lake.

Table A-1 provides a comparison of the vegetation classification systems used in this report to other California Vegetation nomenclature that has been applied to Lake Merced in the past.

A list of species observed during the 1998 surveys is provided in Table A-2. This table also incorporates species lists from previous surveys. The species list is not comprehensive, as the scope of this project focused on dominant species.

Table A-1. Comparison of Vegetation Classification Systems Applied to Vegetation at Lake Merced

General Categories	Types in this report	Types in 1987 report	CNPS series (Sawyer)	Vegetation of California category	CDFG types (Holland)	National Wetland* Inventory Types
Forest types	Monterey pine series	Monterey pine	Monterey pine series	Closed-cone Pine (Pinus radiata)	Monterey pine forest (83130)	N/A
	Monterey cypress stands	Monterey cypress	Monterey cypress stands	Monterey cypress	Monterey cypress forest (83150)	N/A
	Eucalyptus series	eucalyptus	Eucalyptus series	N/A	N/A	N/A
	acacia type	acacia	N/A	N/A	N/A	N/A
Coast LiveOak Seri	arroyo willow series	willow	arroyo willow series	not included	Central Coast riparian scrub (63200)	PSSC
Shrubs types	blackberry type	blackberry	coyote brush series	Northern Coastal Scrub	Northern coyote brush scrub (32110)	N/A
	coyote brush series	coyote brush	coyote brush series	Northern Coastal Scrub (Baccharis scrub)	Northern coyote brush scrub (32110)	N/A
	coyote brush series	North Coastal Scrub	coyote brush series	Northern Coastal Scrub	Northern coyote brush scrub (32110)	N/A
	not included	French broom	Broom series	N/A		N/A
	coyote brush series	yellow bush lupine	yellow bush lupine series	Northern Coastal Scrub (Lupinus scrub)	Northern coyote brush scrub (32110)	N/A
Herbaceous types	California annual grassland series	annual grassland	California annual grassland series	N/A	Non-native grassland (42200)	N/A
	iceplant series	iceplant	iceplant series	N/A	N/A	N/A
	bulrush series	California tule	bulrush series	not included	Coastal and valley freshwater marsh (52410)	PEMF
	water smartweed type	smartweed	no equivalent	not included	Coastal and valley freshwater marsh (52410)	PEMF
	rush type	not included	no equivalent	not included	Coastal and valley freshwater marsh (52410)	PEMC
Other	unvegetated	unvegetated	N/A	N/A	N/A	N/A

*PSSC = Palustrine Scrub-shrub Seasonally Flooded; PEMC = Palustrine Emergent Seasonally Flooded; PEMF = Palustrine Emergent Semiperma , N/A - not applicable

Table A-2. Compiled Plant Species List for Lake Merced

Common Name	Common Name in 1987	Scientific Name	Native	Trihey (1998)	Holloran (1997)	ENTRIX (1987)
Blackwood acacia		*Acacia melanoxylon*		✓		✓
Star acacia		*Acacia verticillata*		✓		✓
Yarrow		*Achillea millefolium*	Y	✓	✓	*Achillea borealis*
Aira		*Aira caryophyllea*		✓		✓
Plume acacia		*Albizia lophantha*		✓		✓
White alder		*Alnus rhombifolia*	Y			✓
Rock cress		*Arabis glabra*	Y		✓	
Madrone		*Arbutus menziesii*	Y	✓		
Pipevine		*Aristolochia californica*	Y	?	?	
California sagebrush		*Artemisia californica*	Y	✓	✓	✓
Slender oat		*Avena barbata*		✓		✓
Coyote brush (prostrate)	Coyote bush (prostrate)	*Baccharis pilularis*	Y	✓	✓	✓
Coyote brush	Coyote bush	*Baccharis pilularis consanguinea*	Y	✓		✓
Quaking grass		*Briza maxima*		✓		
Quaking grass	Rattlesnake grass	*Briza minor*				✓
California brome		*Bromus carinatus*	Y		✓	✓
Riggut brome		*Bromus diandrus*		✓		✓
Soft chess		*Bromus hordeaceus*		✓		*Bromus mollis*
Foxtail chess		*Bromus madritensis ssp. rubens*		✓		*Bromus rubens*
Beach evening primrose		*Camissonia cheiranthifolia*	Y	✓		✓
Sand mat		*Cardionema ramosissimum*	Y	✓		✓
Sedge		*Carex sp.*	Y	✓		✓
Hottentot-fig (ice plant)		*Carpobrotus edulis*		✓		✓
Mouse-ear chickweed		*Cerastium glomeratum*		✓		*Cerastium viscosum*
Soap plant, amole		*Chlorogalum pomeridianum*	Y	✓	✓	
Cobwebby thistle		*Cirsium occidentale var. occidentale*	Y	✓	✓	
Miner's lettuce		*Claytonia perfoliata*	Y	✓		*Montia perfoliata*
Poison hemlock		*Conium maculatum*		✓		✓
Pampas grass		*Cortaderia selloana*		✓		✓
Monterey cypress		*Cupressus macrocarpa*	Y	✓		✓
Wood fern		*Dryopterus arguta*	Y			✓
Powdery dudleya		*Dudleya farinosa*	Y	✓	✓	

Y = native species; Y/I = species may be native or introduced; blank cell = introduced species; ? = reported to document author, but not seen by author; ✓ = observed.

Table A-2. Compiled Plant Species List for Lake Merced

Common Name	Common Name in 1987	Scientific Name	Native	Trihey (1998)	Holloran (1997)	ENTRIX (1987)
		Ehrharta erecta		✓		
Mock heather		*Ericameria ericoides*	Y	✓		*Haplopappus ericoides*
Seaside woolly sunflower	Lizardtail	*Eriophyllum staechadifolium*	Y	✓	✓	✓
Broad-stem filaree		*Erodium botrys*				✓
Red-stem filaree		*Erodium cicutarium*		✓		✓
San Francisco wallflower		*Erysimum franciscanum cf.*	Y	✓	✓	
California poppy		*Eschscholzia californica*	Y	✓	✓	✓
Blue gum eucalyptus		*Eucalyptus globulus*		✓		✓
Fluffweed		*Filago gallica*		✓		
Sweet fennel		*Foeniculum vulgare*		✓		✓
Small-flowered fumaria		*Fumaria parviflora*		✓		
Bedstraw		*Galium sp.*	?	✓		✓
Silk tassel		*Garrya elliptica*	Y			✓
French broom		*Genista monspessulana*		✓		*Cytissus monspessulanus*
Cranesbill		*Geranium sp.*	Y	✓		
Pearly everlasting		*Gnaphalium sp.*	Y/I	✓		✓
English ivy		*Hedera helix*		✓		✓
Toyon		*Heteromeles arbutifolia*	Y	✓		
Ocean spray		*Holodiscus discolor*	Y			✓
Rush		*Juncus sp.*	Y	✓	✓	
Peppergrass		*Lepidium sp.*	Y/I			✓
Sea-lavender		*Limonium sp.*	Y/I	✓		
Sweet alyssum		*Lobularia maritima*				✓
California broom, deerweed		*Lotus scoparius*	Y		✓	
Yellow bush (tree) lupine		*Lupinus arboreus*	Y	✓	✓	✓
Mallow		*Malva sp.*		✓		
California manroot, wild cucumber	Manroot	*Marah fabaceus*	Y	✓		✓
California burclover	Bur clover	*Medicago polymorpha*		✓		*Medicago hispida*
Bush monkeyflower		*Mimulus aurantiacus*	Y	✓	✓	
Myoporum	Closed-pore myoporum	*Myoporum laetum*		✓		✓
Wax myrtle		*Myrica californica*	Y	✓		

Y = native species; Y/I = species may be native or introduced; blank cell = introduced species; ? = reported to document author, but not seen by author; ✓ = observed.

Table A-2. Compiled Plant Species List for Lake Merced

Common Name	Common Name in 1987	Scientific Name	Native	Trihey (1998)	Holloran (1997)	ENTRIX (1987)
Water parsley		*Oenanthe sarmentosa*	Y	✓		✓
Hooker's evening primrose		*Oenothera hookeri*	Y	✓	✓	✓
Bermuda sorrel		*Oxalis pes-caprae*		✓		✓
California phacelia		*Phacelia californica*	Y	✓	✓	
Monterey pine		*Pinus radiata*	Y	✓		✓
English plantain		*Plantago lanceolata*		✓		✓
Common plantain		*Plantago major*		✓		
Annual bluegrass		*Poa annua*		✓		✓
Sand-dune bluegrass		*Poa douglasii*	Y		✓	
Water smartweed	Noxious Weed in Jepson	*Polygonum amphibium var. emersum*	Y	✓	✓	*Polygonum coccineum*
Lombardy poplar		*Populus nigra*				✓
Western chokecherry		*Prunus virginiana demissa*	Y			✓
Bracken		*Pteridium aquilinum*	Y	✓	✓	✓
Coast live oak		*Quercus agrifolia*	Y	✓		✓
Wild radish		*Raphanus sativus*		✓		✓
Watercress		*Rorippa nasturtium-aquaticum*	Y			✓
California wild rose		*Rosa californica*	Y			✓
Thimbleberry		*Rubus parviflorus*	Y			✓
Blackberry		*Rubus ursinus*	Y	✓	✓	✓
Sheep sorrel		*Rumex acetosella*		✓		✓
Red willow	Yellow willow	*Salix laevigata*	Y			✓
Arroyo willow		*Salix lasiolepis*	Y	✓	✓	*Salix lasiolepis bigelovii*
Red elderberry		*Sambucus racemosa*	Y	✓		
California bulrush	California tule	*Scirpus californica*	Y	✓/?		✓
California figwort	Beeplant	*Scrophularia californica*	Y	✓	✓	✓
Purple ragwort		*Senecio elegans*		✓		
Cape ivy	German ivy	*Senecio mikanioides*		✓		✓
London rocket		*Sisymbrium irio*		✓		✓
False Solomon's seal	Star Solomon's seal	*Smilacina stellata*	Y			✓
Nightshade		*Solanum douglasii*	Y			✓
Nightshade		*Solanum sp.*	Y/I	✓		
Goldenrod		*Solidago sp.*	Y		✓	

Y = native species; Y/I = species may be native or introduced; blank cell = introduced species; ? = reported to document author, but not seen by author; ✓ = observed.

Table A-2. Compiled Plant Species List for Lake Merced

Common Name	Common Name in 1987	Scientific Name	Native	Trihey (1998)	Holloran (1997)	ENTRIX (1987)
Tamarisk		*Tamarix sp.*		✓		
New Zealand spinach		*Tetragonia tetragonioides*		✓		
Poison oak		*Toxicodendron diversilobum*	Y	✓	✓	*Toxicodendron diversiloba*
Nasturtium		*Tropaeoleum majus*		✓		*Nasturtium sp.*
Cattail		*Typha latifolia*	Y	✓		✓
Nettle	Nettles	*Urtica dioica ssp. holosericea*	Y	✓		✓
Nettle		*Urtica sp.*	Y			✓
Vetch		*Vicia sp.*	Y/I	✓		✓
Periwinkle		*Vinca major*		✓		✓

Y = native species; Y/I = species may be native or introduced; blank cell = introduced species; ? = reported to document author, but not seen by author; ✓ = observed.

APPENDIX B

WILDLIFE

The animal species discussed in this baseline study are based on observations made during reconnaissance-level site visits conducted by Trihey wildlife biologists in May and June of 1998, and information obtained from the available literature and resource agency databases. Additional information on the regional status and distribution of special status plants, amphibians, reptiles, birds, mammals, fish, and invertebrates potentially occurring in or near the project area was acquired via a search of the California Department of Fish and Game's Natural Diversity Data Base (CNDDB). Supplemental information was also obtained via personal communications with local Audubon Society representatives.

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
Common Name	Scientific Name	Family Name	Listing Status	[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	Reference
Red-throated Loon	*Gavia stellata*	*Gaviidae*							X	2
Pacific Loon	*Gavia pacifica*								X	2
Common Loon	*Gavia immer*								X	2
Pied-billed Grebe**	*Podilymbus podiceps*	*Podicipedidae*					X		X	1,2,3,4,5
Horned Grebe	*Podiceps auritus*								X	2,4,5
Eared Grebe**	*Podiceps nigricollis*						X		X	1,2,4,5
Western Grebe	*Aechmophorus occidentalis*								X	2,4,5
Red-necked Grebe	*Podiceps grisegena*								X	2
Clark's Grebe	*Aechmophorus clarkii*								X	3,4,5
Double-crested Cormorant	*Phalacrocorax auritus*	*Phalacrocoracidae*					X		X	1,2,4,5
Brandt's Cormorant	*Phalacrocorax penicillatus*								X	2
Least Bittern	*Ixobrychus exilis*	*Ardeidae*					X			2
American Bittern	*Botaurus lentiginosus*						X			3,4
Great Blue Heron	*Ardea herodias*						X			1,2,4,5
Great Egret	*Casmerodius albus*						X			2,4,5
Snowy Egret	*Egretta thula*						X			2,4
Green Heron	*Butorides virescens*				X		X			1,4,5
Black-crowned Night Heron	*Nycticorax nycticorax*				X		X			1,2,4,5
Tundra Swan	*Cygnus columbianus*	*Anatidae*							X	3
Snow Goose	*Chen caerulescens*						X		X	5
Canada Goose	*Branta canadensis*						X	X	X	2,5
Green-winged Teal	*Anas crecca*								X	3,4,5
Mallard**	*Anas platyrhynchos*						X	X	X	1,2,4,5
Northern Pintail	*Anas acuta*								X	2
Blue-winged Teal	*Anas discors*								X	2,3
Cinnamon Teal	*Anas cyanoptera*								X	2,4,5
Ruddy Duck	*Oxyura jamaicensis*						X		X	1,2,4,5
Northern Shoveler	*Anas clypeata*								X	2,4
Gadwall	*Anas strepera*								X	2,5
American Wigeon	*Anas americana*								X	2,5
Canvasback	*Aythya valisineria*								X	2,4
Redhead	*Aythya americana*								X	2
Ring-necked Duck	*Aythya collaris*								X	2,4,5
Tufted Duck	*Aythya fuligula*								X	3

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
Common Name	Scientific Name	Family Name	Listing Status	[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	Reference
Greater Scaup	*Aythya marila*								X	2,4,5
Lesser Scaup	*Aythya affinis*								X	5
Surf Scoter	*Melanitta perspicillata*								X	2,5
White-winged Scoter	*Melanitta fusca*								X	2,5
Common Goldeneye	*Bucephala clangula*								X	2
Bufflehead	*Bucephala albeola*								X	2,5
Common Merganser	*Mergus merganser*								X	2
Red-breasted Merganser	*Mergus serrator*								X	2
White-tailed Kite	*Elanus leucurus*	*Accipitridae*				X	X			5
Cooper's Hawk	*Accipiter cooperii*			X						2,5
Sharp-shinned Hawk	*Accipiter striatus*			X		X				2,5
Red-shouldered Hawk	*Buteo lineatus*			X	X	X				1,3,4,5
Broad-winged Hawk	*Buteo platypterus*			X		X				3
Red-tailed Hawk	*Buteo jamaicensis*			X	X					2,5
Osprey	*Pandion haliaetus*			X						2,5
American Kestrel	*Falco sparverius*	*Falconidae*		X						1,2,4,5
Merlin	*Falco columbarius*			X		X				3,4,5
Peregrine Falcon	*Falco peregrinus*		SE FE	X						3
California Quail	*Callipepla californicus*	*Phasianidae*			X	X				3
Clapper Rail	*Rallus longirostris*	*Rallidae*	SE FE				X		X	3
Virginia Rail	*Rallus limicola*				X		X		X	2,4,5
Sora	*Porzana carolina*				X		X		X	2,4,5
Black Rail	*Laterallus jamaicensis*		ST FSC				X		X	3
Common Moorhen	*Gallinula chloropus*						X		X	2,5
American Coot**	*Fulica americana*						X		X	1,2,5
Killdeer	*Charadrius vociferous*	*Charadriidae*						X		1,4,5
Solitary Sandpiper	*Tringa solitaria*	*Scolopacidae*							X	4
Spotted Sandpiper	*Actitis macularia*							X		1,5
Common Snipe	*Capella gallinago*				X	X		X		4,5
Red-necked Phalarope	*Phalaropus lobatus*								X	4,5
Red Phalarope	*Phalaropus fulicarius*								X	4,5
Sanderling	*Calidris alba*							X		5
Curlew Sandpiper	*Calidris ferruginea*							X		4
Semipalmated Sandpiper	*Calidris pusilla*							X	X	4

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
Common Name	Scientific Name	Family Name	Listing Status	[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	Reference
Western Sandpiper	*Calidris mauri*						X	X	X	4
Least Sandpiper	*Calidris miniutilla*						X	X		4
Pectoral Sandpiper	*Calidris melanotos*						X	X		4
Bonaparte's Gull	*Larus philadelphia*	*Laridae*							X	4,5
Heermann's Gull	*Larus heermanni*								X	4,5
Mew Gull	*Larus canus*								X	4,5
Ring-billed Gull	*Larus delawarensis*								X	1,4,5
Herring Gull	*Larus argentatus*								X	4,5
California Gull	*Larus californicus*								X	1,4,5
Thayer's Gull	*Larus thayeri*								X	4
Western Gull	*Larus occidentalis*								X	1,4,5
Glaucous-winged Gull	*Larus glaucescens*								X	4,5
Caspian Tern	*Sterna caspia*								X	1,5
Forster's Tern	*Sterna forsteri*								X	5
Rock Dove	*Columba livia*	*Columbidae*				X				1,5
Mourning Dove	*Zenaida macroura*					X				1,5
Great Horned Owl	*Bubo virginianus*	*Strigidae*		X	X					5
White-throated Swift	*Aeronautes saxatalis*	*Apodidae*							X	5
Anna's Hummingbird**	*Calypte anna*	*Trochilidae*			X	X				1,4,5
Rufous Hummingbird	*Selasphorus rufus*			X	X	X				4
Allen's Hummingbird	*Selasphorus sasin*			X	X	X				1,4,5
Belted Kingfisher	*Ceryle alcyon*	*Alcedinidae*			X				X	5
Northern Flicker	*Colaptes auratus*	*Picidae*		X						1,5
Downy Woodpecker	*Picoides pubescens*			X						1,4,5
Hairy Woodpecker	*Picoides villosus*			X						5
Western Kingbird	*Tyrannus verticalis*	*Tyrannidae*		X						5
Ash-throated Flycatcher	*Myiarchus cinerascens*			X	X	X				5
Dusky-capped Flycatcher	*Myiarchus tuberculifer*			X						5
Olive-sided Flycatcher	*Contopus borealis*			X						1,5
Western Wood-Pewee	*Contopus sordioulus*			X	X	X				1
Black Phoebe	*Sayornis nigricans*				X	X	X		X	4,5
Pacific-slope Flycatcher	*Empidonax difficilis*			X	X					4,5
Tree Swallow	*Tachycineta bicolor*	*Hirundinidae*		X	X	X	X		X	1,4,5
Violet-green Swallow	*Tachycineta thalassina*			X	X	X	X		X	1,4,5

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
Common Name	Scientific Name	Family Name	Listing Status	[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	Reference
Northern Rough-winged Swallo	*Stelgidopteryx ruficollis*				X	X	X	X	X	4,5
Cliff Swallow**	*Hirundo pyrrhonota*				X	X	X	X	X	1,4,5
Barn Swallow	*Hirundo rustica*				X	X	X	X	X	1,4,5
Bank Swallow	*Riparia riparia*		ST		X	X	X	X	X	1,4,5
Scrub Jay	*Aphelocoma coerulescens*	*Corvidae*		X		X				1,5
American Crow	*Corvus brachyraynchos*			X		X				1,5
Common Raven	*Corvus corax*					X				4,5
Chestnut-backed Chickadee	*Parus rufescens*	*Paridae*		X	X					1,4,5
Bushtit	*Psaltriparus minimus*	*Aegithalidae*		X	X	X				1,4,5
Pygmy Nuthatch	*Sitta canadensis*	*Sittidae*		X						4,5
Brown Creepers	*Certhia americana*	*Certhidae*		X	X					4,5
Bewick's Wren	*Thryomanes bewickii*	*Troglidytidae*				X	X			4,5
Winter Wren	*Troglodytes troglodytes*			X	X					5
Marsh Wren**	*Cistothorus palustris*				X		X			1,4,5
Golden-crowned Kinglet	*Regulus satrapa*	*Muscicapidae*		X						5
Ruby-crowned Kinglet	*Regulus calendula*			X						2,4,5
Blue-gray Gnatcatcher	*Polioptila caerulea*			X		X				4
Hermit Thrush	*Catharus guttatus*			X						4,5
Varied Thrush	*Ixoreus naevius*			X						4
American Robin**	*Turdus migratorius*			X		X				1,4,5
Wrentit	*Chamaea fasciata*	*Muscicapidae*				X				5
Northern Mockingbird	*Mimos polyglottos*	*Mimidae*		X		X				1
American Pipit	*Anthus rubescus*	*Motacillidae*						X		2
Water Pipit	*Anthus pacificus*							X		2
Cedar Waxwing	*Bombycilla cedrorum*	*Bombycillidae*		X	X	X				2,4,5
Loggerhead Shrike	*Lanius ludovicianus*	*Laniidae*				X				2
European Starling**	*Sturnus vulgaris*	*Sturnidae*		X						1,2,5
Solitary Vireo	*Vireo solitarius*	*Vireonidae*		X						2
Hutton's Vireo	*Vireo huttoni*			X						2,5
Yellow-green Vireo	*Vireo flavoviridis*			X						2
Warbling Vireo	*Vireo gilvus*			X						2,5
Tennessee Warbler	*Vermivora peregrina*	*Emberizidae*		X	X					4
Orange-crowned Warbler	*Vermivora celata*			X	X					1,2,4,5
Nashville Warbler	*Vermivora ruficapilla*			X	X	X				2

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
				[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	
Common Name	Scientific Name	Family Name	Listing Status							Reference
Virginia's Warbler	*Vermivora virginiae*			X						2
Lucy's Warbler	*Vermivora luciae*				X	X				5
Northern Parula	*Parula americana*			X	X					2,4,5
Black-and-white Warbler	*Mniotilta varia*			X	X	X				2,4
Yellow-rumped Warbler	*Dendroica coronata*			X	X	X				2,4,5
Myrtle Warbler	*Dendroica hooveri*			X	X	X				5
Audubon's Warbler	*Dendroica auduboni*			X	X	X				5
Black-throated Gray Warbler	*Dendroica nigrescens*			X	X					5
Townsend's Warbler	*Dendroica townsendi*			X	X					4,5
Hermit Warbler	*Dendroica occidentalis*			X	X					2
Blackpoll Warbler	*Dendroica striata*			X	X	X				2,4
Palm Warbler	*Dendroica palmarum*				X					4
Yellow Warbler	*Dendroica petechia*				X					1,2,5
MacGillivray's Warbler	*Oporonis tolmiei*			X	X					5
Common Yellowthroat	*Geothlypis trichas*		FSC		X		X			1,4,5
Canada Warbler	*Wilsonia canadensis*			X	X	X				4
Wilson's Warbler	*Wilsonia pusilla*				X					1,2,4,5
Northern Waterthrush	*Seiurus noveboracensis*					X	X			2,4,5
America Redstart	*Setophaga ruticilla*			X	X					2,4,5
Spotted Towhee	*Pipilo erythrophthalmus*				X	X				2,5
California Towhee	*Pipilo crissalis*				X	X				2,5
Savannah Sparrow	*Passerculus sandwichensis*					X	X			1,4
Song Sparrow**	*Melospiza melodia*					X				1,2,4,5
Dark-eyed Junco	*Junio hyemalis*			X						2
White-throated Sparrow	*Zonotrichia albicollis*				X	X				2
White-crowned Sparrow	*Zonotrichia leucophrys*					X				1,2,4,5
Golden-crowned Sparrow	*Zonotrichia atricapilla*				X	X				2,4,5
Fox Sparrow	*Passella iliaca*				X					2,4,5
Lincoln's Sparrow	*Melospiza lincolnii*				X	X				2,4,5
Swamp Sparrow	*Melospiza georgiana*				X		X			4,5
Western Meadowlark	*Sturnella neglecta*					X				2
Red-winged Blackbird	*Agelaius phoeniceus*					X	X			2,4,5
Tricolored Blackbird	*Agelaius tricolor*						X			2,4,5
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*						X			4

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
Common Name	Scientific Name	Family Name	Listing Status	[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	Reference
Brewer's Blackbird**	*Euphagus cyanocephalus*			X		X				1,2,4,5
Brown-headed Cowbird	*Molothrus ater*				X	X				1,2,4,5
Northern Oriole	*Icterus galbula*				X	X				2,4
Western Tanager	*Piranga ludoviciana*			X	X	X				2,4,5
Summer Tanager	*Piranga rubra*			X	X	X				4
Pine Siskin	*Carduelis pians*	*Fringilidae*		X	X	X				2,5
American Goldfinch	*Carduelis tristis*					X				2,5
Lesser Goldfinch	*Carduelis psaltria*				X	X				2
Red Crossbill	*Loxia curvirostra*			X						2,5
Purple Finch	*Carpodacus purpureus*			X		X				1,2,4,5
Cassins' Finch	*Carpodacus cassinii*			X		X				1
House Finch	*Carpodacus mexicanus*			X		X				1,2,4,5
House Sparrow	*Passer domesticus*	*Passeridae*		X	X	X		X		2,5
TOTAL NUMBER OF BIRDS SUMMARIZED BY HABITAT				69	63	63	40	18	#	

Reference Sources:
1. Trihey 1998. Observations from 5/27/98 and 6/2/98 Site Visits
2. ENTRIX 1987.
3. Murphy 1997.
4. Richer, C. (ed) 1985.
5. Murphy 1998.

Notes:
(ST) - State-listed threatened
(SE) - State-listed endangered
(FE) - Federally listed endangered
(FSC) - Federal species of concern

Habitat:
*Habitat use includes foraging, nesting, breeding, resting, and refuge. For purposes of simplifying the habitat and bird species associations, groupings of the habitat describe in section (xx) were created. The following are equivalant groupings of the habitat:
[1]Coniferous and Hardwood Forest = Monterey pine series, Montery cypress stands, Eucalyptus series, Coast live oak

Table B-1. Bird Species occurence and Habitats at Lake Merced.

Bird Species				Associated Lake Merced Habitats*						
Common Name	Scientific Name	Family Name	Listing Status	[1]Coniferous and Hardwood Forest	[2]Arroyo Willow Riparian	[3]Shrub/Grassland	[4]Bulrush/Smartweed	Unvegetated Shoreline	Aquatic	Reference

series, and acacia type.

[2]Arroyo Willow Riparian = Arroyo willow series

[3]Shrub/Grassland = Coyote brush series, blackberry type, California annual grassland series, and Iceplant series

[4]Bulrush/smartweed = Bulrush series, water smartweed type, and rush type

**Evidence of nesting in area including observations of juvenile and /or nests during May and June 1998 field visits.

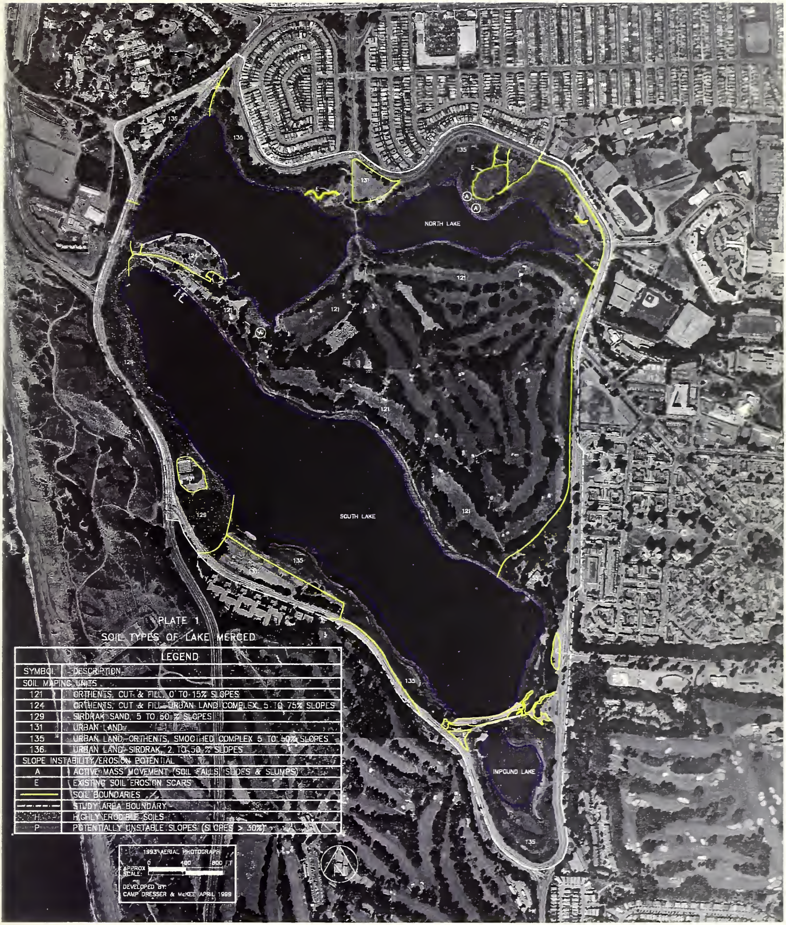


PLATE 1
SOIL TYPES OF LAKE MERCED

LEGEND	
SYMBOL	DESCRIPTION
SOIL MAPING UNITS	
121	ORTHENTS, CUT & FILL, 0 TO 15% SLOPES
124	ORTHENTS, CUT & FILL–URBAN LAND COMPLEX, 5 TO 75% SLOPES
129	SIRDRAK SAND, 5 TO 50 % SLOPES
131	URBAN LAND
135	URBAN LAND–ORTHENTS, SMOOTHED COMPLEX 5 TO 50% SLOPES
136	URBAN LAND–SIRDRAK, 2 TO 50 % SLOPES
SLOPE INSTABILITY/EROSION POTENTIAL	
A	ACTIVE MASS MOVEMENT (SOIL FALLS, SLIDES & SLUMPS)
E	EXISTING SOIL EROSION SCARS
—	SOIL BOUNDARIES
— - — - —	STUDY AREA BOUNDARY
H	HIGHLY ERODIBLE SOILS
P	POTENTIALLY UNSTABLE SLOPES (SLOPES > 30%)

1993 AERIAL PHOTOGRAPH
APPROX SCALE: 0 400 800 FT

DEVELOPED BY:
CAMP DRESSER & McKEE APRIL 1999

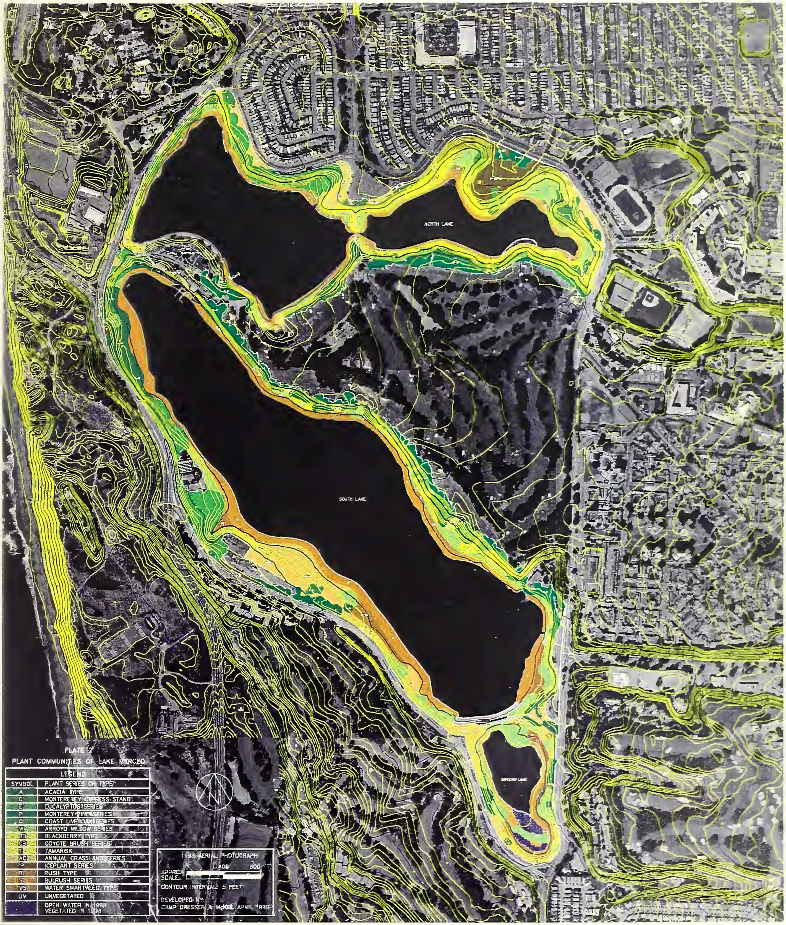
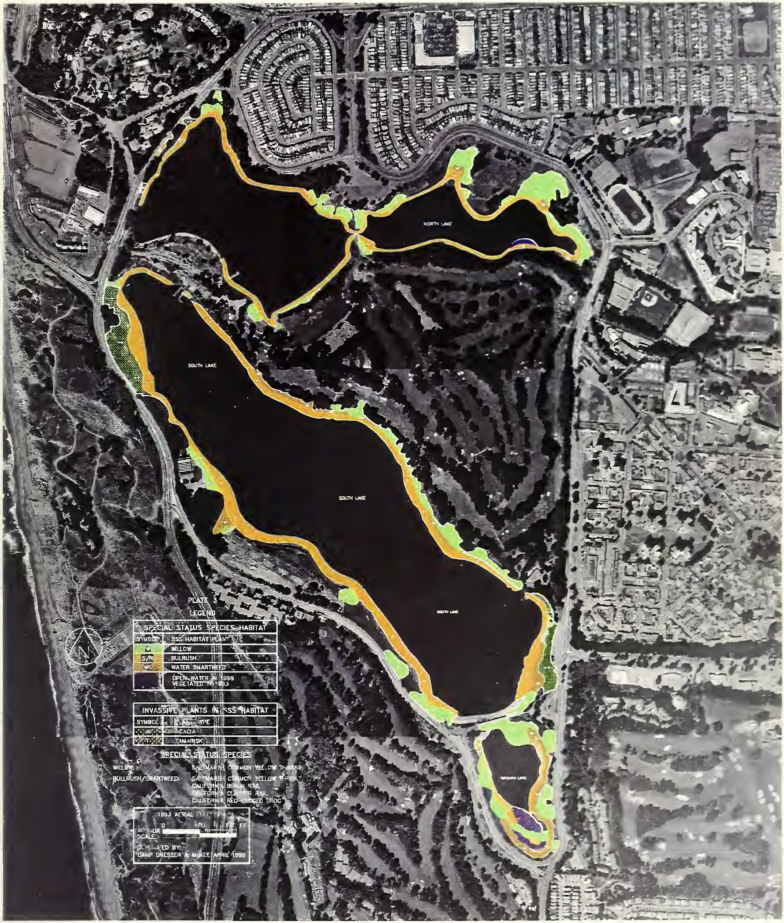
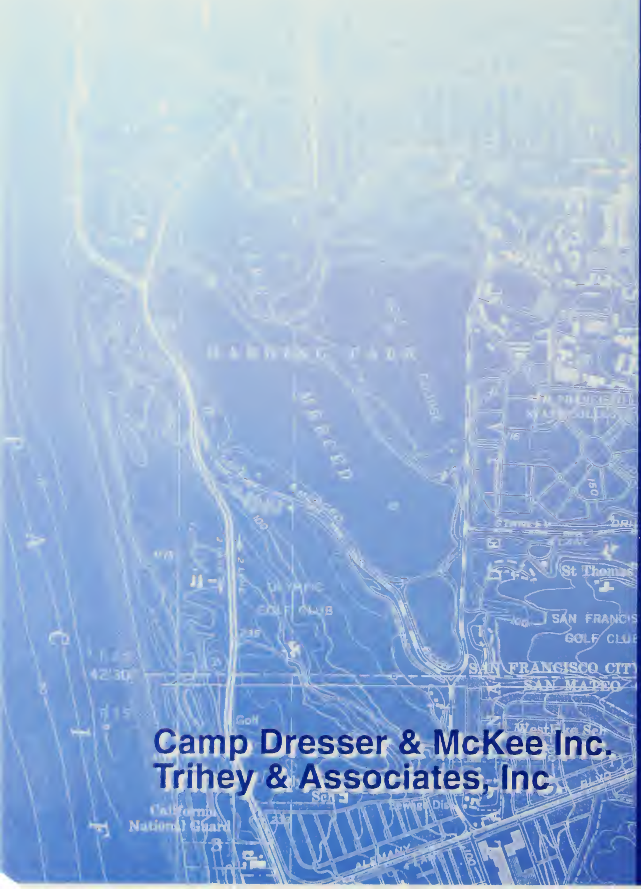


PLATE 2

PLANT COMMUNITIES OF LAKE MERCED


NORTH LAKE
SOUTH LAKE
SOUTH LAKE
SOUTH LAKE
N
PLATE 3
LEGEND
SPECIAL STATUS SPECIES HABITAT
SYMBOL
SSS HABITAT PLANT
W
WILLOW
S/R
BULRUSH
WS
WATER SMARTWEED
OPEN WATER IN 1998
VEGETATED IN 1993
INVASSIVE PLANTS IN SSS HABITAT
SYMBOL
PLANT TYPE
A
ACACIA
T
TAMARISK
SPECIAL STATUS SPECIES
WILLOW:
SALTMARSH COMMON YELLOW THROAT
BULLRUSH/SMARTWEED:
SALTMARSH COMMON YELLOW THROAT
CALIFORNIA BLACK RAIL
CALIFORNIA CLAPPER RAIL
CALIFORNIA RED-LEGGED FROG
1993 AERIAL PHOTOGRAPH
APPROX SCALE:
0
400
800 FT
DEVELOPED BY:
CAMP DRESSER & McKEE APRIL 1998



Camp Dresser & McKee Inc.
Trihey & Associates, Inc.